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SUPRAGENERIC CLASSIFICATION OF THE RHIZOPODEA

ALFRED R. LOEBLICH, JR. AND HELEN TAPPAN

California Research Corporation, La Habra, California and University of California at Los Angeles

ABSTRACT—A proposed suprageneric classification of the class Rhizopodea is given, with particular revision of the order Foraminiferida. For each category of the proposed classification a complete synonomy is attempted, including family group names originally proposed as new, variant spellings, emended terminations and transfers from one family group status to another, all with full references.

The subclass Lobosia contains the orders Amoebida and Arcellinida (each with two superfamilies) and Mycetozoida (with three suborders). The subclass Filosia includes the orders Aconchulinida and Gromida (the latter with two superfamilies), and the subclass Granuloreticulosia contains the orders Athalamida, Monothalamida and Foraminiferida (with 17 superfamilies, based on the test wall composition and structure), Xenophyophorida and Proteomyxida.

New family group names proposed herein are the families Pocheinidae, Penardiidae and Biomyxidae, and subfamilies Dianemininae, Tawitawiinae, Pavonitininae, Umbellininae, Stacheiinae, Cyclogyrinae, Lingulininae, Oolininae, Hedbergellinae, Truncorotaloidinae, Rupertininae, and Fursenkoininae.

Corrected names herein are the subclass Lobosia (*pro* Lobosa), order Xenophyophorida (*pro* Xenophyophora), suborder Sorophorina (*pro* Sorophora), superfamilies Ceratiomyxacea (*pro* Ceratiomyxioidea), Stemonitacea (*pro* Stemonitidides), Trichiacea (*pro* Trichiides), Gromiacea (*pro* Gromiides), Lagynacea (*pro* Lagynidea), Ammodiscacea (*pro* Ammodiscoidea), Lituolacea (*pro* Lituolidea), Parathuramminacea (*pro* Parathuramminidea), Endothyracea (*pro* Endothyridea), Fusulinacea (*pro* Fusulinoidea), Miliolacea (*pro* Miliolidea), Nodosariacea (*pro* Nodosariidea), Buliminacea (*pro* Buliminidea), Rotaliacea (*pro* Rotaliidea), Globigerinacea (*pro* Globigerinidea), Orbitoidacea (*pro* Orbitoidicae) and Spirillinacea (*pro* Spirillinidea); family Plasmodiophoridae (*pro* Plasmodiophoreae), subfamilies Physarinae (*pro* Physarei), Didymiinae (*pro* Didymiei) Stemonitinae (*pro* Stemonitei), Trichiinae (*pro* Trichiei), Arcyriinae (*pro* Arcyrie), Loftusiinae (*pro* Loftusinae), Loeblichiinae (*pro* Loeblichinae), Discospirinae (*pro* Discospiriinae), Glandulininae (*pro* Glandulinea), Fabulariinae (*pro* Fabularidea) and Pleurostomellinae (*pro* Pleurostomellidae).

Names which have been corrected and elevated in rank (*nom. transl.*) include the subclasses Filosia (*ex* order Filosa) and Granuloreticulosia (*ex* order Granuloreticulosa).

Family group names which have been elevated or lowered in rank (*nom. transl.*) include the following superfamilies elevated from family status: Pelomyxacea (*ex* Pelomyxidae), Tetramitacea (*ex* Tetramitidae), Arcellacea (*ex* Arcellidae), Cryptodifflugiacea (*ex* Cryptodifflugiidae), Euglyphacea (*ex* Euglyphidae), Diplophryacea (*ex* Diplophyridae), Asterigerinacea (*ex* Asterigerinidae), Cassidulinacea (*ex* Cassidulinidae), Robertinacea (*ex* Robertinidae) and Carterinacea (*ex* Carter-

Editor's note.—Publication of this manuscript was made possible by generous financial support from California Research Corporation.

inidae). Families elevated from subfamily status include the Paraquadrulidae (*ex* Paraquadrulinae), Botellinidae (*ex* Botellininae). Nouriidae (*ex* Nouriinae), Moravamminidae (*ex* Moravammininae), Colaniellidae (*ex* Colaniellinae), Turrilinidae (*ex* Turrilininae), Sphaeroidinidae (*ex* Sphaeroidininae), Bolivinitidae (*ex* Bolivinitinae), Eouvigerinidae (*ex* Eouvigerininae), and Caucasinidae (*ex* Caucasininae). Subfamilies lowered from family or tribe status herein include the Collodermidae (*ex* Collodermaceae), Amaurochaetinae (*ex* Amaurochaetaceae), Cribariinae (*ex* Cribrariaceae), Liceinae (*ex* Liceoidei), Tubiferinae (*ex* Tubiferae Reticulariinae (*ex* Reticulariaceae), Lycogalinae (*ex* Lycogalaceae), Ventrolamininae (*ex* Ventrolaminidae), Barkerininae (*ex* Barkerinidae), Tuberitininae (*ex* Tuberitinidae), Nodosinellinae (*ex* Nodosinellidae), Ptychocladiinae (*ex* Ptychocladiidae), Enantiomorphininae (*ex* Enantiomorphinidae), Gavelinellinae (*ex* Gavelinellidae) and Epistomininae (*ex* Epistominidae).

Five new generic names are proposed to replace homonyms on which family group names had been based: *Pocheina* (*pro Guttulina* Cienkowski, 1873, *non Guttulina* d'Orbigny, 1839), *Dianemina* (*pro Dianema* Rex, 1891, *non Dianema* Cope, 1871), *Umbellina* (*pro Umbella* Maslov, 1955, *non Umbella* d'Orbigny, 1841), *Rupertina* (*pro Rupertia* Wallich, 1877, *non Rupertia* Gray, 1865), and *Fursenkoina* (*pro Virgulina* d'Orbigny, 1826, *non Virgulina* Bory de St. Vincent, 1823).

INTRODUCTION

FOR the past decade the writers have been concerned with preparation of the section on the class Rhizopodea (Section 2, part 3), for the *Treatise on Invertebrate Paleontology*, with emphasis on the smaller Foraminifera and the so-called Testacea. All described genera in these groups are to be included therein with illustrations, descriptions, and synonymy.

The many recent advances in micropaleontological and zoological knowledge and techniques showed the necessity for separation and reallocation of many genera previously regarded as closely related. In order to have a uniform basis for separation of the various suprageneric categories, a general reclassification was undertaken. As new taxons are generally not presented in compilations such as the *Treatise*, the proposed new classification is here presented in brief outline, with listing of the various suprageneric categories and their definitions. For the sake of brevity, no listing of the included genera is given here as they will appear in the forthcoming *Treatise*.

The second and equally important purpose of the present paper arose from this reclassification and consists of citation of all family group names previously proposed for categories within the class Rhizopodea of the subphylum Sarkodina, together with original references, authors, and dates.

FAMILY GROUP NOMENCLATURE

The laws of priority state that all valid family group names (superfamilies, tribes, families and subfamilies) are of equivalent rank and subject to identical rules for purposes of availability and priority. These names must be based on that of a type genus, and the prescribed family and subfamily suffixes must be used. The name acquires availability, authorship, and rank of priority from the date of the first publication as a family group name of any category, regardless of its later elevation or lowering in rank. Thus no superfamily can include a family of prior date, nor can a family include a subfamily of earlier date. The difficulties inherent in ascertaining the oldest family group names were recognized by the International Commission on Zoological Nomenclature, and the suggestion was made that compilations of described family group names, citing author and date, be prepared and published for each taxonomic group by the specialists concerned. A major chore in the preparation of the rhizopod section of the Treatise has been to locate the oldest valid available name for each of the subdivisions of the classification herein proposed.

Very few publications on Foraminifera or other rhizopods have cited authors and date for family group names (notable exceptions being Poche, 1913, Galloway, 1933, Copeland, 1956, and Rauser-Chernousova & Fursenko, 1959), and few articles on smaller groups or assemblages have done this. Only the publications of Poche and Galloway cited the actual reference for these family group names. *There is no published listing of all previously proposed suprageneric catego-*

ries, even the above mentioned references giving only the author and date of the family group names recognized or utilized in their classification. Taxonomy of the order Foraminiferida has thus been at its most chaotic at the family group level. Family names have been wrongly credited, junior synonyms used preferentially, new names used without statement as to their first proposal, and the same family name unwittingly proposed as new by as many as four or five authors.

Some of the family group names here listed were found in papers, texts and treatises whose titles would suggest the presence of a reclassification, but by far the majority were located as obscure references in the text of faunal papers or stratigraphic discussions without comment in title or abstract. Some original family group names were proposed in footnotes, and bibliographic indexes. Many first references were listed without comment as to the novelty of the new term.

For the reasons given above, we have attempted to list every previously published family group name that has been used for a category within the class Rhizopodea of the subphylum Sarkodina. The complete first reference is given—original spelling, author, reference, and date. In addition, later emendations in spelling (both valid and invalid changes) and transfers from one family group category to another are listed, as are invalid names (such as those not based on the name of an included genus). No synonymous homonyms are listed (subsequent proposals as new of the same name that had previously been proposed elsewhere), if these are identical in form, spelling, and rank of classification as they are without standing in nomenclature. No emendations or revisions as to family concept or scope are included in this synonymy, as only nomenclatural changes are listed herein. It is hoped that these synonymies will be useful to future workers who can thus ascertain whether or not family group names have already been proposed for a taxon which they regard as distinct.

In order to avoid duplication, all synonymic subfamily names are included only under the appropriate subfamily, and family references (including transferred names) listed only under the family concerned. In some cases, other categories (orders, suborders, "family groups," etc.) have been listed under the superfamilies when their descriptions have indicated that they were equivalent, although these other categories have no standing for purposes of priority in the family group nomenclature. In using this index, one might therefore look under family, subfamily, and superfamily headings in order to be certain whether a family group name has been based previously on a given generic name.

As a result of this compilation of early citations, the date and authorship of many family group names differs herein from that previously cited elsewhere (about one-fourth of these are changed). Many prior references (fortunately to the same names in most instances) were located in the present study. In the event that some have still been overlooked, we welcome correction. It is strongly urged that publications on these groups in the future continue to cite author and date for any family group names used, as then no ambiguity will arise as to their first date of publication, and less future revisionary work will be necessary.

The somewhat lengthy list of references cited includes *only those publications to which reference was made herein*, that is, only those which contained new family group names or emendations of these names. It is not a bibliography of classifications as there are many important references on taxonomy of the Rhizopodea which have not included new taxonomic categories.

RECLASSIFICATION OF THE RHIZOPODEA

During the dozen years that have elapsed since the appearance of the last major American text on the classification of the Foraminiferida (Cushman, 1948), there have been a half dozen major revisions in other languages (including those of Sigal *in* Piveteau, 1952; LeCalvez and Deflandre *in* Grassé, 1953; Pokorný, 1954, 1958; and Rauser-Chernousova & Fursenko, 1959). In addition, many revisions have appeared on individual families or groups of families. Advances in our knowledge of the protozoans from these revisionary publications and many other sources have been evaluated

in formulating the classification here proposed. We have attempted to stabilize the classification by a greater uniformity of the criteria used in the separation of the different categories. Many of the criteria here regarded as of major importance were unknown even ten years ago, hence have not been mentioned in any American texts. The rapid advances in the past ten years in the use of microscopic wall structure, chemical composition, internal morphology (as observed by microdissections as well as by thin-sectioning), coiling ratios, ontogenetic development, life histories, and even type of gametes, form of pseudopodia, mode of protoplasmic movement, and methods of reproduction must be considered in a classification. By a "reverse" uniformitarianism, we may assume that the "past is a key to the future" also, and that equally important future advances in as yet unsuspected directions are to be expected. The present classification thus is not likely to be a final one, but is an indication of the present state of knowledge in these groups. It is relatively conservative in the number of family groups recognized in proportion to the number which have been proposed.

Similar sweeping changes have been made during the last three decades in the classification of the "Testacea" (deSaedeleer, 1934 and Deflandre *in* Grassé, 1953), which are now generally distributed among various larger groups of the Rhizopodea on the basis of their protoplasmic characters. Although the *Treatise on Invertebrate Paleontology* is concerned largely with those groups which either have been or could be found as fossils, their suprageneric nomenclature is closely interrelated with other groups which are known only from living representatives, hence the latter are also included herein.

The outline of classification below is accompanied by a minimum of discussion, with the recognized superfamily, family, and subfamily names followed by their synonymy and a brief diagnosis of the distinguishing characters. In mimeographed form, an outline of this classification has been used in classes in micropaleontology taught by Helen Tappan (Loeblich) at the University of California at Los Angeles. Eight of the families of the order Foraminiferida (larger Foraminifera, fusulines, alveolinids, and orbitolinids) will be covered by other authors for the *Treatise*, but their suprageneric nomenclature is nevertheless included here.

The present classification follows the generally current separation of the class Rhizopodea into the subclasses Lobosia, Filosia and Granuloreticulosia based on the protoplasmic nature of the pseudopodia. Thus the old "Testacea" or Thecamoebina lie partly within each of these subclasses. The orders are separated by the presence or absence of a protective covering, shell, or test. Within the naked rhizopods, all other divisions are necessarily based on the protoplasmic nature, life cycle, etc.; but among the testaceous forms of all three subclasses, the superfamilies are separated on the basis of the test wall composition and structure. Families are separated on shell development, general method of chamber arrangement, and basic apertural characteristics, and on life histories as far as such information is available. Subfamily characters include modifications of walls, chambers and septa, and apertural and developmental patterns.

Recent studies by Jahn & Rinaldi (1959) have suggested the possibility of a redivision of the Rhizopodea, on the basis of the type of protoplasmic movement, a two-way subdivision placing the Actinopodea with the Filosia and Granuloreticulosia as opposed to the Lobosia.

Another possible basis for reallocation at higher levels is the type of gametes present in those forms with sexual reproduction. On this basis also the Lobosia are separated (sexual reproduction has not yet been confirmed for this group). The large majority of both the Filosia and Granuloreticulosia as well as the Radiolarida have flagellate gametes. The superfamily Spirillinacea is distinctive among the Foraminiferida in having amoeboid gametes, although they have been reported also in *Allogromia* (conjugation has not been confirmed as yet). These members of the Granuloreticulosia would on this basis be allied with the Heliozoa which also have amoeboid gametes. Although this basis has been used herein to support separation of the Spirillinacea as a distinct superfamily (in addition to distinctive wall characters) and to regard it as highly developed (loss of the flagellate stage is an advanced rather than primitive char-

acter), too little information is yet available for a major reseparation of the Rhizopodea on this basis. As the life cycles have been studied as yet for only a very minor number of the foraminiferal genera, probably not over one or two percent, it is too early to more than suggest the importance of this character in classification and to recommend it for future research.

To summarize briefly the superfamily categories of testaceous rhizopods (those which at least theoretically might be found as fossils):

Arcellacea: Pseudopodia lobose, not anastomosing, test a rigid membrane.

Cryptodifflugiacea: Pseudopodia anastomosing, test a rigid membrane.

Gromiacea: Pseudopodia filose, test chitinous or agglutinated.

Euglyphacea: Pseudopodia filose, test of siliceous scales.

Diplophryacea: Pseudopodia granuloreticulose, test chitinous or calcareous. No alternation of generations.

Lagynacea: Pseudopodia granuloreticulose, test gelatinous to chitinous, alternation of generations, some parasitic.

Ammodiscacea: Test agglutinated, nonseptate.

Lituolacea: Test agglutinated, septate.

Parathuramminacea: Test of calcareous granules in calcareous cement, nonseptate.

Endothyracea: Test calcareous, granular or fibrous, generally with two distinct layers, septate.

Fusulinacea: Test calcareous, granular, basically with three distinct layers in the wall, perforate.

Miliolacea: Test calcareous, porcellanous, with proloculus and tubular chamber or chambers.

Nodosariacea: Test calcareous, wall perforate, radial in structure, aperture slitlike or radiate, and may have entosolenian tube.

Buliminacea: Test high-spired, wall calcareous, perforate, radial in structure, aperture an interiomarginal or areal slit, or terminal, commonly with internal toothplate.

Asterigerinacea: Test trochospiral, wall perforate, radial, laminated calcite, noncanaliculate, single walls and septa.

Rotaliacea: Test trochospiral to planispiral, wall perforate, radial, laminated calcite, canaliculate.

Globigerinacea: Test enrolled, chambers globular, test walls lamellar, of perforate radial hyaline calcite, habit planktonic.

Orbitoidacea: Test enrolled, walls double, of laminated calcite, perforate radial structure, primarily formed double septa.

Cassidulinacea: Test enrolled, high or low spired, wall of perforate granular calcite, aperture interiomarginal or areal, slitlike or loopshaped or multiple.

Carterinacea: Test of calcareous secreted spicules, trochospiral.

Robertinacea: Test trochospiral, chambers with internal partitions, wall aragonitic, perforate radial in structure, primary aperture an areal slit, with secondary aperture above partition.

Spirillinacea: Test calcareous, optically acts as a single crystal of calcite, perforate, proloculus followed by tubular second chamber or later septate. Includes the only Foraminifera known to develop amoeboid rather than flagellate gametes.

Xenophyophorida (Order): Spongin-like system of hollow tubes, with foreign material in the interstices resulting in agglutinated appearance.

TERMINATIONS USED IN THE PRESENT CLASSIFICATION

In 1936, a list of phyla, classes, and orders was prepared for the American Association for the Advancement of Science (Pearse, 1936) in which uniform endings for various ranks of taxonomic groups were strongly urged. The terminations recommended in this publication for class *-ea*, subclass *-ia*, order *-ida*, and suborder *-ina* are here used. This system has previously been used in the Protozoa by Jahn and Jahn (1949) and by Hall (1953).

Family and subfamily endings (*-idae* and *-inae* respectively) are specified by the *Rules of Zoological Nomenclature*, but to date no standard terminations have been used for superfamilies. Even previously published parts of the *Treatise* are not consistent, and superfamily terminations varied according to the author or group concerned. In consultation with R. C. Moore, editor of the *Treatise on Invertebrate Paleontology*, the

termination *-acea* was determined as preferable for the superfamily category and is utilized herein.

ABBREVIATIONS USED IN THE SYNONYMY

Family group names used in the present classification are shown in capitals in the centered subheads. The following abbreviations are used herein after synonymic references, in the style utilized by the *Treatise on Invertebrate Paleontology* (Moore, 1957, p. xi), their definitions being listed for utility. These abbreviations are the addition of the writers and listed as here regarded. In many instances we have listed *nom. correct.* or *nom. transl.* after family groups names which their author cited as new, although they were in reality homonyms, or variations or corrections in spelling or terminations before these were specified by the Rules.

nom. conserv. = *nomen conservatum.* Name otherwise unacceptable under application of the Rules, which is made valid, either with original or altered spelling, through procedure specified by the Copenhagen decisions or by action of the ICZN exercising its plenary powers.

nom. correct. = *nomen correctum.* Name with intentionally altered spelling of the sort required or allowable under the Rules, but not dependent on transfer from one taxonomic category to another ("improved name").

nom. imperf. = *nomen imperfectum.* Name that as originally published meets all mandatory requirements of the Rules but contains defect needing correction ("imperfect name").

nom. neg. = *nomen negatum.* Name with invalid original spelling and *not* correctable to establish original authorship and date ("denied name"). Examples are the many citations in the French, German, or Italian vernacular which are not latinized.

nom. nud. = *nomen nudum.* Name that as originally published fails to meet mandatory requirements of the Rules and having no status in nomenclature is not correctable to establish original authorship and date ("naked name").

nom. null. = *nomen nullum.* Name consisting of unintentional alteration in spelling (misprint, *lapsus calami*, etc.) of previously published name.

nom. subst. = *nomen substitutum.* Replacement name published as substitute for an invalid name such as a junior homonym (equivalent to "new name").

nom. transl. = *nomen translatum.* Name that is derived by valid emendation of a previously published name as a result of transfer from one taxonomic category to another within the group to which it belongs ("transferred name"). This includes changes in rank (*i.e.*, from subfamily to family, etc.) and not merely changes in inferred relationships (transferral of a subfamily or family to a different family or superfamily from the original placement but without change in rank).

nom. van. = *nomen vanum.* Name consisting of an invalid intentional change in form (spelling) from a previously published name, such invalid emendations having status in nomenclature as junior objective synonyms ("vain or void names").

ACKNOWLEDGMENTS

The somewhat lengthy list of references cited, in which original or variant suprageneric terms appeared, is scarcely an indication of the vast number of references that had to be checked in the course of preparation of the synonymies. Completion of the work would scarcely have been possible without the considerable aid of various libraries and their librarians. Particular mention and acknowledgment is due to the librarians of the University of California at Los Angeles, including those of the departmental Geology and Biomedical libraries, and the Reference Librarian of the General Library, who obtained numerous obscure publications through inter-library loan.

During visits to Stanford University, Stanford, California, assistance was given the writers by J. J. Graham in the use of library facilities in the School of Mineral Sciences, and library courtesies were also extended by the Biology Library and the library of the Museum of Natural History at Stanford.

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University of Southern California, Los Angeles, and the library of the Rancho Santa Ana Botanic Garden, Claremont, California.

One of the greatest obstacles in the present work was the general scarcity of Russian literature in the western hemisphere. In obtaining many of the publications grateful acknowledgment is made of the cooperation of Dr. L. Dain, Professor Z. G. Stschedrina and Professor N. N. Subbotina of Leningrad, and Professor A. V. Fursenko of Minsk.

OUTLINE OF CLASSIFICATION

Subphylum SARKODINA Hertwig & Lesser, 1874

Class Sarkodina HERTWIG & LESSER, 1874, p. 43.
Section Pantostomata KENT, 1880, p. 34, 36, 37.
Grade Gymnomyxa LANKESTER, 1878; *fide* Lankester, 1885, p. 838, 839.
Class Sarcodina CALKINS, 1901, p. 105.
Subphylum Sarcodina CALKINS, 1909, p. 38.
Class Sarcodina (Rhizopoda *s. l.*) HOOGENRAAD & DE GROOT, 1940, p. 24.
Subphylum Mastigamoebaea CORLISS, 1960, p. 172, 187 (*partim*).

Class RHIZOPODEA von Siebold, 1845

Class Rhizopodea JAHN & JAHN, 1949, p. 108.
Rhizopodes DUJARDIN, 1835, p. 314 [*nom. neg.*].
Symplectomeres DUJARDIN, 1835, p. 109 [*nom. neg.*].
Family Rhizopodes DUJARDIN, 1841, p. 126, 240 [*nom. neg., nom. nud.*].
Class Rhizopoda VON SIEBOLD, *in* von Siebold & Stannius, 1845, p. 3.
Subsection Rhizopoda PRITCHARD, 1861, p. 201.
Acyttaria HAECKEL, 1862, p. 211.
Monothalamia HAECKEL, 1862, p. 211.
Monothalamia Rhizopoda HERTWIG & LESSER, 1874, p. 110.
Section Pantostomata KENT, 1880, p. 36 (*partim*).
Class Rhizopodia DELAGE & HÉROUARD, 1896, p. 59.
Subphylum Plasmodroma DOFLEIN, 1902, p. 171 (*partim*).
Subphylum Plasmodromata HARTMANN, 1907, p. 140.
Class Rizópodos FERNÁNDEZ GALIANO, 1921, p. 19 [*nom. neg.*].
Subclass Rhizopoda KUDO, 1931, p. 177.
Superclass Rhizopodes DEFLANDRE *in* Grassé, 1953, p. 3 [*nom. neg.*].
Superclass Rhizopoda DEFLANDRE *in* Edmondson, 1959, p. 233.

Unicellular organisms with amoeboid, non-flagellate principal stage, characterized by the presence of pseudopodia which lack axial filaments, majority not parasitic, have no meganucleus, may have flagellate gametes, more rarely amoeboid gametes.

Subclass LOBOSIA Carpenter, Parker & Jones, 1862, *nom. correct.*

Subclass Lobosia LOEBLICH & TAPPAN, herein [*nom. correct. pro* subclass Lobosa Chatton, 1925].
Order Lobosa CARPENTER, PARKER & JONES, 1862, p. 23.
Order Rhizopoda sphygmica HAECKEL, 1862, p. 211.
Protoplasta HAECKEL, 1870, p. 56 (*partim*).
Monothalamia Lobosa HERTWIG & LESSER, 1874, p. 93.
Order Protoplasta LEIDY, 1879, p. 23 (*partim*).
Suborder Lobosa LEIDY, 1879, p. 23.
Section Lobosa LANKESTER, 1885, p. 838.
Class Lobosa LANKESTER, 1885, p. 838, 841.
Subclass Amoebiae DELAGE & HÉROUARD, 1896, p. 89.
Family Lobosa WEST, 1901, p. 309 [*nom. nud.*].
Subclass Amebea CALKINS, 1909, p. 39.
Subclass Chaoinea POCHE, 1913, p. 168 (*partim*).
Subclass Lobosa CHATTON, 1925, p. 76.
Subclass Amoebina KÜHN, 1926, p. 107, 108.
Subclass Amoebaea CALKINS, 1926, p. 324.
Subclass Amoebina (Rhizopoda *s. s.*) HOOGENRAAD & DE GROOT, 1940, p. 24.

Pseudopodia lobose, very rarely filiform or anastomosing, naked forms with protoplasm differentiated into endoplasm and ectoplasm, and shelled forms with zonal differentiation of protoplasm frequent. Plasmodia may develop by fusion of individual amoebulae in some forms. Protoplasmic movement by means of a flow of plasmasol caused by differential pressure due to con-

traction of plasmagel cortex (see Jahn & Rinaldi, 1959, p. 101).

Order AMOEBIDA Ehrenberg, 1830

Amoebida HAECKEL, 1862, p. 211.
Ordre Les Infusoires Homogènes CUVIER, 1817, p. 92 [*nom. neg.*].
Amoebaea EHRENBERG, 1830, p. 59.
Ordo Monostega DIESING, 1848, p. 497, (*partim*).
Order Homogenea CUVIER, 1851, p. 660, 707 (*partim*).
Nuda SCHULTZE, 1854, p. 52.
Order Proteina CLAPARÈDE & LACHMANN, 1859, p. 435 (*partim*).
Suborder Amoebina CLAUS, 1872, p. 116.
non Family Nuda CLAUS, 1872, p. 108 (= Protomyxidae Poche, 1913).
Order Amoeboidea LANKESTER, 1877, p. 442.
Order Amoebina KENT, 1880, p. 36.
Suborder Amoebaea BÜTSCHLI *in* Bronn, 1880, p. 176 (*partim*).
Order Nuda LANKESTER, 1885, p. 842.
Order Amoebinen HERTWIG, 1893, p. 149 [*nom. neg.*].
Order Monostegia HAECKEL, 1894, p. 164 (*partim*).
Order Gymnamoebida DELAGE & HÉROUARD, 1896, p. 89.
Suborder Gymnamoebina CALKINS, 1901, p. 105.
Suborder Nuda CALKINS, 1901, p. 106 (*non* family Nuda Claus, 1872).
Section Nuda MINCHEN, 1912, p. 217.
Order Chaidea POCHE, 1913, p. 170.
Order Amibos FERNÁNDEZ GALIANO, 1921, p. 23 [*nom. neg.*].
Order Amoebae CHATTON, 1925, p. 76.
Order Gymnamoebaea KÜHN, 1926, p. 108.
Order Amoebida (Gymnamoebida) CALKINS, 1926, p. 337.
Order Testamoebida EPSTEIN, 1926, p. 200, 208.
Order Nuda (Gymnamoeba) HOOGENRAAD & DE GROOT, 1940, p. 24 (= Nuda Schultze 1854; *non* family Nuda Claus, 1872).
Order Amoebaea DEFLANDRE *in* Grassé, 1953, p. 123.
Suborder Amoeboidina BOVEE, 1957, p. 65.

No thick pellicle or test; cytoplasm differentiated into hyaline and homogeneous ectoplasm and granulated or vacuolated endoplasm; pseudopodia blunt and broad (lobopodia); typically with single nucleus; flagellate stage may occur; reproduction asexual, commonly by binary fission; free-living in fresh or salt water, soil or parasitic.

Superfamily PELOMYXACEA Schulze, 1877, *nom. transl.*

Superfamily Pelomyxacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Pelomyxidae Schulze, 1877].
Suborder Amastigogenina CHATTON *in* Grassé, 1953, p. 54.

No flagellate stage in life history, life cycle limited to amoeboid stage and a cyst.

Family PELOMYXIDAE Schulze, 1877

Family Pelomyxidae SCHULZE, 1877, p. 26.
Family Amibiens DUJARDIN, 1841, p. 226 [*nom. neg.*].
Family Amoebaea DIESING, 1848, p. 495.
Family Amoebeae DIESING, 1848, p. 497.
Family Amoebea MAITLAND, 1851, p. 3 [*nom. correct. pro* family Amoebeae Diesing, 1848].
Family Amoebina PERTY, 1852, p. 188 [*nom. correct. pro* family Amoebeae Diesing, 1848].
Family Amoebidae BRONN, 1859, p. 67 [*nom. correct. pro* family Amoebeae Diesing, 1848].
Family Amoebaea lobosa BÜTSCHLI *in* Bronn, 1880, p. 176.
Family Monamoebina HAECKEL, 1894, p. 164 [*nom. nud.*].
Family Chaidae POCHE, 1913, p. 171 [*nom. subst. pro* family Amoebeae Diesing, 1848].
Family Monamoebidae CHATTON, 1925, p. 76 [*nom. correct. pro* family Monamoebina Haeckel, 1894, *nom. nud.*].
Family Schizopyrenidae SINGH, 1951, p. 584 [*nom. nud.*].
Family Chaosidae CHATTON *in* Grassé, 1953, p. 54 [*nom. correct. pro* family Chaidae Poche, 1913].

Amoebae commonly of large size, possessing one or more nuclei; movement by means of indeterminate pseudopodia (may appear in any position on the body), involving streaming of the granular endoplasm; multiplication by binary or multiple fission. Generally free living, but a few are parasitic. Fresh or salt water or damp soil.

Remarks.—The family name Amoebidae would have priority, except that the generic

name *Amoeba* Ehrenberg, 1830 (pro *Amiba* Bory de St. Vincent, 1822), is a junior synonym of *Chaos* Linné, 1767. The family name Pelomyxidae has priority over the name Chaosidae, proposed as a substitute name for the Amoebidae.

Family THECAMOEBIDAE Chatton, 1925

Family Thecamoebidae CHATTON, 1925, p. 76 (*non* order Thecamoebida Delage & Hérouard, 1896).

Family Thecamoebida COPELAND, 1956, p. 201, 202 [*nom. van.*].

Body commonly ovoidal to circular in outline, and without formation of pseudopodia during locomotion; surface covered with double layered impermeable pellicle which may be longitudinally ridged. Habitat subaerial, fresh water.

Remarks.—The family Thecamoebidae, based on the genus *Thecamoeba* Fromental (order Amoebida) is not related to the protozoans placed in the order Thecamoebida Delage & Hérouard, 1896 (=Testacea Schultze, 1854, Testacealobosa de Saedeleer, 1934, etc.).

Family HYALODISCIDAE Poche, 1913

Family Hyalodiscidae POCHE, 1913, p. 182.

Family Hyalodiscida COPELAND, 1956, p. 201, 202 [*nom. van.*].

Discoidal body with granular endoplasm and thin layer of homogeneous ectoplasm, no pellicle, pseudopodia indeterminate (may appear in any position). Marine and fresh water.

Family HARTMANNELLIDAE Volkonsky, 1931

Family Hartmannellidae SINGH, 1951, p. 584 [*nom. transl. ex* subfamily Hartmannellinae Volkonsky, 1931].

Subfamily Hartmannellinae VOLKONSKY, 1931, p. 330.

Amoebae of small size, free living in soil, coprophilous or parasitic. Separated by type of mitotic division (mesomitosis).

Family CHAETOPROTEIDAE Poche, 1913

Family Chaetoproteidae POCHE, 1913, p. 172.

Family Mayorellidae SCHAEFFER, 1926, p. 12, 47.

Family Mayorellida COPELAND, 1956, p. 201, 202 [*nom. van.*].

Family Chaetoproteida COPELAND, 1956, p. 163 [*nom. van.*].

Amoebae of medium to large size; conical or tapering determinate pseudopodia (always appear in the same place on the body), anterior pseudopodium of clear, nongranular cytoplasm. Fresh water and marine.

Family ENTAMOEBIDAE Chatton, 1925

Family Entamoebidae CHATTON, 1925, p. 76.

Family Endamoebidae CALKINS, 1926, p. 338.

Family Testamoebidae EPSTEIN, 1926, p. 200, 208.

Subfamily Endamoebinae CHATTON *in* Grassé, 1953, p. 62 [*nom. transl. ex* family Endamoebidae Calkins, 1926].

Subfamily Entamoebinae CHATTON *in* Grassé, 1953, p. 65 [*nom. transl. ex* family Entamoebidae Chatton, 1925].

Family Dientamoebidae GRASSÉ, 1953, p. 50.

Family Endamoebida COPELAND, 1956, p. 201, 202 [*nom. van.*].

Parasitic amoebae, vegetative form small, generally occurring in the alimentary canal of the host, multiplication by binary fission, encystment common.

Remarks.—Previously regarded as synonymous, the genera *Endamoeba* Leidy, 1879 and *Entamoeba* Casagrandi & Barbagallo, 1895 are now separated on the basis of nuclear characters.

Family PANSPORELLIDAE Chatton, 1953

Family Pansporellidae CHATTON *in* Grassé, 1953, p. 78.

Family Sporamoebidae CHATTON, 1925, p. 75, 76 [*nom. nud.*].

Amoebae parasitic in arthropods, cysts give rise to spores from which arise binucleate amoebulae which develop into vegetative stage. Spores differ from those of the Sporozoa in being permeable.

Superfamily TETRAMITACEA Kent, 1880 *nom. transl.*

Superfamily Tetramitacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Tetramitidae Kent, 1880].

Order Rhizo-Flagellata KENT, 1880, p. 220 (*partim*).

Family group Polystomata RHUMBLER, 1928, p. 4 (*partim, non* Polystomata Averintsev, 1906).

Suborder Mastigogenina CHATTON *in* Grassé, 1953, p. 37.

Order Rhizomastigina KUDO, 1939, p. 235.

Life cycle includes both flagellate and amoeboid stage. Originally classed with Class Flagellata, or considered as separate order of the subclass Zoomastigina (Kudo, 1954, p. 333), but due to possession of pseudopodia and the loss of the flagellum during part of the life cycle they are here classed with the Amoebida.

Family MASTIGAMOEBIDAE Chatton, 1925

Family Mastigamoebidae CHATTON, 1925, p. 76.

Family Rhizomastigina BÜTSCHLI *in* Bronn, 1884, p. 810 (*partim*) [*nom. nud.*].

Family Rhizomastigidae CALKINS, 1901, p. 137 [*nom. correct. pro* family Rhizomastigina Bütschli, 1884, *nom. nud.*].

Family Rhizoflagellates CHATTON *in* Grassé, 1953, p. 37 [*nom. neg.*].

Amoebae of medium to large size, with a flagellum during at least part of the life cycle, free or parasitic.

Remarks.—The family was credited to Goldschmidt, 1907 by Chatton (*in* Grassé, 1953, p. 37), but Goldschmidt used the terms Rhizomastiginen (p. 160) and Mastigamöben (p. 161) in the vernacular, not as latinized names, and none was used by Goldschmidt in the sense of family name. The family Rhizomastigina Bütschli, 1884, and the corrected name Rhizomastigidae Calkins, 1901, are invalid, as *nomina nuda*. They were not based on the later described *Rhizomastix* Alexeiff, 1911. The term Rhizoflagellates is a vernacular reference (in the synonymy of the Mastigamoebidae) to the order Rhizo-Flagellata Kent, 1880. The earliest valid family reference is that of Chatton, 1925.

Family PARAMOEBIDAE Poche, 1913

Family Paramoebidae POCHE, 1913, p. 173.

Amoebae possessing a paranucleus in addition to the normal nucleus, may produce cysts which give rise to flagellate spores.

Remarks.—The authorship of this family was credited to Schaudinn by Chatton (*in* Grassé, 1953, p. 42). However, Schaudinn described only the genus *Paramoeba*, and gave no family. The family was first named by Poche, 1913. Furthermore, Calkins (1933, p. 456) cites Doflein as the author of the family.

Family TETRAMITIDAE Kent, 1880

Family Tetramitidae KENT, 1880, p. 312.

Family Bistadiidae DOFLEIN, 1916, p. 667 [*nom. nud.*].

Family Vahlkampfidae JOLLOS, 1917, p. 261.

Family Vahlkampfidae ZULUETA, 1917, p. 12.

Family Dimastigamoebidae WENYON, 1926, p. 160, 174, 260.

Family Vahlkampfiidae CHATTON *in* Grassé, 1953, p. 46 [*nom. correct. pro* family Vahlkampfidae Jollos, 1917].

Family Naegleriidae KUDO, 1954, p. 435.

Amoebae small, free or coprophilous, producing biflagellate forms, normally uninucleate, no spores, cysts very resistant.

Order MYCETOZOIDA de Bary, 1859

Order Mycetozoida CALKINS, 1901, p. 18 [*nom. correct. pro* order Mycetozoa de Bary, 1859; not = Mycetozoida Schepotieff, 1912].

Order Mycetozoa DE BARY, 1859, p. 88.

Suborder Myxogastres FRIES, 1829, p. 3, 67.

Myxomycetes WALLROTH, 1833, *fide* Lister & Lister 1925, p. xiii.

Mycetozoen DE BARY, 1859, p. 88 [*nom. neg.*].

Schleimpilze DE BARY, 1859, p. 88 [*nom. neg.*].

Class Mycetozoa ROSTAFINSKI, 1873, p. 1.

Class Zygosporeae LUERSSEN, 1879, p. 3.

Order Myxomycetes LUERSSEN, 1879, p. 38.

Myxomyceten DE BARY, 1884, p. 453 [*nom. neg.*].

Monadinen (Monadineae) ZOPF, 1885, p. 98 (*partim*).

Section Plasmodiata LANKESTER, 1885, p. 838.

Order Phytomyxini SCHROETER, 1886, p. 133.

Order Myxogasteres SCHROETER, 1886, p. 91, 98.

Myxomyceteae BERLESE *in* Saccardo, 1888, p. 323.

Class Myxomycetes BENNETT & MURRAY, 1889, p. 401.
Mycetozoen (Eumycetozoen) ZOPF, 1892, p. 45 [*nom. neg.*].
Order Phytomyxinae MCBRIDE, 1892, p. 111.
Myxothallophyta SCHRÖTER, 1897a, p. iii.
Class Phytomyxinae SCHRÖTER, 1897b, p. iii, 5.
Class Myxogasteres (eigentliche Myxomyceten) SCHRÖTER, 1897c, p. iii, 8.
Subclass Mycetozoa SEDGWICK, 1898, p. 15.
Class Myxomycetes MACBRIDE, 1899, p. 16.
Subclass Phytomyxinae MACBRIDE, 1899, p. 16.
Subclass Myxogastres MACBRIDE, 1899, p. 20.
Suborder Myxogastres MORGAN, 1900, p. 119.
Suborder Mycetozoidea DOFLEIN, 1901, p. 47.
Suborder Phytomyxinae DOFLEIN, 1911, p. 672.
Suborder Myxogasteres DOFLEIN, 1911, p. 682.
Myxozoa SCHEPOTIEFF, 1912, p. 267 (*partim*).
Eumycetozoa SCHEPOTIEFF, 1912, p. 267 (*partim*).
Suborder Phytomyxinea POCHE, 1913, p. 197.
Order Mycetozoen (Schleimtiere) HERTWIG, 1919, p. 188 [*nom. neg.*].
Myxomyceten (Schleimpilze) HERTWIG 1919, p. 188 [*nom. neg.*].
Mixogasteros FERNÁNDEZ GALIANO, 1921, p. 41 [*nom. neg.*].
Micetozoos FERNÁNDEZ GALIANO, 1921, p. 39 [*nom. neg.*].
Order Pilztiere RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 106 [*nom. neg.*].
Order Schleimpilze RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 106 [*nom. neg.*].
Myxomyzeten RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 107 [*nom. van.*].
Order Phytomyxida CALKINS, 1926, p. 328.
Class Archimycetes GÄUMANN & WYND, 1952, p. 13 (*partim*) [not entirely equal to Archimycetes Fischer, 1892].
Division Myxomycophyta SMITH, 1955, p. 346.
Class Plasmodiophoreae SMITH, 1955, p. 356.
Order Myxomycetales BONNER, 1959, p. 4.
Order Myxogastrales BONNER, 1959, p. 4.
Holozoic or saprozoic organisms, previously regarded as related to fungi, but shown by their development to be protozoans. Large multinucleate plasmodium, formed by fusion of many myxamoebae. Cytoplasm granulated except for thin hyaline and homogeneous external layer, the granules in some forms being of calcium carbonate. Life cycle complex, plasmodium variously developing resting cysts which later reform into plasmodia, or sporangia containing numerous spores. Spores develop into amoeboid stage, later into biflagellate bodies, then encyst and finally reform into myxamoebae which fuse into plasmodia.

Suborder SOROPHORINA Lankester, 1885, *nom. correct.*

Suborder Sorophorina LOEBLICH & TAPPAN, herein [*nom. correct. pro* suborder Sorophora Minchin, 1912].
Order Sorophora LANKESTER, 1885, p. 840.
Family Acrasiées VAN TIEGHEM, 1880, p. 322 [*nom. neg.*].
Group Sorophoreen ZOPF, 1885, p. 131 [*nom. neg.*].
Acrasieae DE BARY, 1887, p. 421, 441.
Acrasieen DE BARY, 1887, p. 475 [*nom. neg.*].
Sorophoreae BERLESE *in* Saccardo, 1888, p. 324.
Order Acrasiei SCHROETER, 1886, p. 97.
Class Acrasieae BENNETT & MURRAY, 1889, p. 405.
Order Sorophoreen ZOPF, 1892, p. 45 [*nom. neg.*].
Suborder Acrasieae ZOPF, 1892, p. 45.
Acrasidea HAECKEL, 1894, p. 164.
Order Pseudoplasmodiés DELAGE & HÉROUARD, 1896, p. 77 [*nom. neg.*].
Order Pseudoplasmodida DELAGE & HÉROUARD, 1896, p. 77.
Order Acrasieae OLIVE, 1902, p. 452.
Subclass Sorophora J. J. LISTER *in* Lankester, 1909, p. 37.
Order Dictyosteliaceae J. J. LISTER *in* Lankester, 1909, p. 37.
Order Guttulinaceae J. J. LISTER *in* Lankester, 1909, p. 37.
Order Acrasiae CALKINS, 1909, p. 38.
Suborder Sorophora MINCHIN, 1912, p. 243.
Suborder Acrasinea POCHE, 1913, p. 175.
Suborder Acrasieos FERNÁNDEZ GALIANO 1921, p. 39 [*nom. neg.*].

Order Acrasida CALKINS, 1926, p. 328.
Order Acrasiales MARTIN *in* Ainsworth & Bixby, 1950, p. 411.
Suborder Acrasina HALL, 1953, p. 227, 228.
Order Acrasiés PAVILLARD *in* Grassé, 1953, p. 493 [*nom. neg.*].
Order Sorophorae PAVILLARD *in* Grassé, 1953, p. 493.

Myxamoebae grouped prior to spore formation, but do not fuse to form a true plasmodium; no flagellate stage.

Family SAPPINIIDAE Olive, 1901

Family Sappiniidae DOFLEIN, 1909, p. 587 [*nom. correct. pro* family Sappiniaceae Olive, 1901].
Family Sappiniaceae OLIVE, 1901, p. 334.

Myxamoebae form pseudospores (with rigid but unthickened walls) directly, without fruiting bodies.

Family POCHEINIDAE Loeblich & Tappan, *nom. subst.*

Family Pocheinidae LOEBLICH & TAPPAN, herein [*nom. subst. pro* family Guttulinidae Doflein, 1909, and family Guttulinacei Schroeter, 1886; *nomina nuda*, based on *Guttulina* Cienkowski, 1873, not *Guttulina* d'Orbigny, 1839].
Family Guttulineen ZOPF, 1885, p. 132 [*nom. neg.*].
Family Guttulinacei SCHROETER, 1886, p. 97 [*nom. nud.*, see above].
Family Guttulineae BERLESE *in* Saccardo, 1888, p. 451 [*nom. correct. pro* family Guttulinacei Schroeter, 1886].
Family Guttulinaceae ZOPF, 1892, p. 45 [*nom. correct. pro* family Guttulinacei Schroeter, 1886].
Family Guttulinidae DOFLEIN, 1909, p. 587 [*nom. correct. pro* family Guttulinacei Schroeter, 1886].
Family Guttuliniidae KUDO, 1931, p. 190 [*nom. van. pro* family Guttulinidae Doflein, 1909].
Subfamily Guttulininae DOFLEIN & REICHENOW, 1952, p. 725 [*nom. transl. ex* family Guttulinidae Doflein, 1909].
Family Guttulinacea COPELAND, 1956, p. 201, 203 [*nom. van.*].

Plasmodium incomplete, myxamoebae of "limax" form, may form pseudospores or true spores in a fruiting body on a short thick stalk.

Remarks.—The family Guttulinidae was based on the genus *Guttulina* Cienkowski, 1873, a junior synonym of *Guttulina* d'Orbigny, 1839, a foraminifer. *Pocheina* Loeblich & Tappan, *nom. nov.*, is herein proposed to replace *Guttulina* Cienkowski, 1873, Trudy chetvert. siezda Russ. Estest. po otdiedeniyo botan. anat. 1 fiz. rastenii, sess. 4, Aug. 26, 1873, Bot. Sect., p. 11. The type species is *Guttulina rosea* Cienkowski, 1873 = *Pocheina rosea* (Cienkowski). The generic name is in honor of F. Poche, in recognition of his excellent work on protozoan taxonomy. Because the family Guttulinidae was based on a homonym, the new family name Pocheinidae Loeblich & Tappan is here proposed, with *Pocheina* Loeblich & Tappan as type genus.

Family DICTYOSTELIIDAE Rostafinski, 1873

Family Dictyosteliidae KUDO, 1931, p. 190 [*nom. correct. pro* family Dictyosteliaceae Rostafińskie, 1875].
Tribe Dictyosteliaceae ROSTAFINSKI, 1873, p. 4.
Family Dictyosteliaceae ROSTAFIŃSKIE, 1875, p. 32, 86, 217 [*nom. transl. ex* tribe Dictyosteliaceae Rostafinski, 1873].
Family Acrasiées VAN TIEGHEM, 1880, p. 322 [*nom. neg.*].
Family Dictyosteliaceen ZOPF, 1885, p. 134 [*nom. neg.*].
Dictyosteliacei SCHROETER, 1886, p. 97 [*nom. correct. pro* family Dictyosteliaceae Rostafińskie, 1875].
Family Acrasacées VAN TIEGHEM, 1898, p. 21 [*nom. neg.*].
Family Pseudoplasmodidae DOFLEIN, 1901, p. 47 [*nom. nud.*].
Family Dictyostelidae DOFLEIN, 1909, p. 587, 588 [*nom. correct. pro* family Dictyosteliaceae Rostafińskie, 1875].
Family Acrasieae HARTOG *in* Harmer & Shipley, 1906, p. x, 90.
Family Acrasidae POCHE, 1913, p. 177 [*nom. correct. pro* family Acrasieae Hartog, 1906].
Subfamily Dictyostelinae DOFLEIN & REICHENOW, 1952, p. 725 [*nom. transl. ex* family Dictyostelidae Doflein, 1909].

Pseudoplasmodium complete; myxamoebae with short pointed pseudopodia. True

spores formed in fruiting bodies with cellulose sheath.

Suborder PLASMODIOPHORINA Cook, 1928

Suborder Plasmodiophorina HALL, 1953, p. 227, 228 [*nom. transl. ex* order Plasmodiophorales Cook, 1928].

Monadineae zoosporae ZOPF, 1885, p. 115 (*partim*).

Order Phytomyxini SCHROETER, 1886, p. 133 (*partim*).

Zoosporeae BERLESE *in* Saccardo, 1888, p. 453 (*partim*).

Order Chytridineae SCHROETER, 1893, *fide* Fitzpatrick, 1930, p. 38.

Suborder Phytomyxinées TORREND, 1907, p. 37, 60 [*nom. neg.*].

Suborder Phytomyxinae DOFLEIN, 1911, p. 672.

Mycetozoa SCHEPOTIEFF, 1912, p. 267 (*partim*).

Suborder Phytomyxinea POCHE, 1913, p. 197.

Suborder Fitomixinos FERNÁNDEZ GALIANO, 1921, p. 40 [*nom. neg.*].

Order Plasmodiophorales COOK, 1928, *fide* Karling, 1942, p. 2.

Order Protococcales CLEMENTS & SHEAR, 1931, p. 30 (*partim*).

Subclass Phytomyxinae HAGELSTEIN, 1932, p. 241.

Order Plasmodiophorales COOK, 1933, p. 179.

Class Phytomyxinae SMITH, 1938, p. 360.

Large multinucleate amoeboid body; parasitic in plants, more rarely in animals.

Remarks.—The genus *Phytomyxa* (basis for the order Phytomyxina) is not related to the Rhizopodea, and the order Chytridiales consists of true fungi. The earliest valid name is therefore the order Plasmodiophorales Cook, 1928, reduced to suborder rank by Hall, 1953.

Family PLASMODIOPHORIDAE Berlese, 1888, *nom. correct.*

Family Plasmodiophoridae LOEBLICH & TAPPAN, herein [*nom. correct. pro* family Plasmodiophoreae Berlese, 1888].

Family Plasmodiophoreen ZOPF, 1885, p. 129 [*nom. neg.*].

Family Gymnococcaceen ZOPF, 1885, p. 126 [*nom. neg.*].

Family Phytomyxacei SCHROETER, 1886, p. 133.

Family Plasmodiophoreae BERLESE *in* Saccardo, 1888, p. 453.

Family Gymnococcaceae BERLESE *in* Saccardo, 1888, p. 453.

Family Plasmodiophorinae DELAGE & HÉROUARD, 1896, p. 76 [*nom. correct. pro* family Plasmodiophoreae Berlese, 1888].

Family Gymnococcinae DELAGE & HÉROUARD, 1896, p. 75 [*nom. correct. pro* family Gymnococcaceae Berlese, 1888].

Family Zoosporidae DOFLEIN, 1901, p. 41 [*non* Zoosporeae Hartog, 1906; *nom. nud.*].

Family Azoosporeae HARTOG *in* Harmer & Shipley, 1906, p. x, 89 (*partim*) [*nom. nud.*].

Family Phytomyxidacées TORREND, 1907, p. 37, 39, 43, 60 [*nom. neg.*].

Family Phytomyxaceae MIGULA, 1910, p. 6 [*nom. correct. pro* family Phytomyxacei Schroeter, 1886].

Family Plasmodiophoraceae SCHEPOTIEFF, 1912, p. 267 [*nom. correct. pro* family Plasmodiophoreae Berlese, 1888].

Family Phytomyxidae POCHE, 1913, p. 198 [*nom. correct. pro* family Phytomyxacei Schroeter, 1886].

Family Gymnococcidae POCHE, 1913, p. 198 [*nom. correct. pro* family Gymnococcaceae Berlese, 1888].

Family Plasmodiophorea COPELAND, 1956, p. 179 [*nom. neg.*].

Characters as in the suborder.

Remarks.—The genus *Sorosphaera* Schroeter, 1886 (p. 135), with type species *S. veronicae* Schroeter, is a homonym of *Sorosphaera* Brady, 1879, a foraminifer. The genus *Ligniera* Maire & Tison, 1911, with type species *Sorosphaera junci* Swartz, 1910, has been regarded as a synonym of *Sorosphaera* Schroeter, as it was based solely on a different host reaction. With suppression of *Sorosphaera* Schroeter as a junior homonym, the name *Ligniera* is the next valid name available, and should be used for those species previously referred to *Sorosphaera* Schroeter.

Suborder EUMYCETOZOINA Poche, 1913

Suborder Eumycetozoina HALL, 1953, p. 227, 230 [*nom. correct. pro* suborder Eumycetozoa Poche, 1913].

Order Uterini veri FRIES, 1821, p. xliv.

Suborder Trichospermi FRIES, 1821, p. xliv.
Class Gasteromycetes FRIES, 1821, p. xxxv, xlviii (*partim*).
Order Trichospermi FRIES, 1823, p. 276.
Order Gasteromycetes genuina FRIES, 1829, p. 1 (*partim*).
Eumycetozoen ZOPF, 1885, p. 131 (*partim*) [*nom. neg.*].
Suborder Eumycetozoa POCHE, 1913, p. 199.
Gastromyzetes RHUMBLER *in* Kükenthal & Krumbach, 1926, p. 106 (*partim*).
Order Enteridiea COPELAND, 1956, p. 171.
Spores develop into myxoflagellates; myxamoebae fuse completely to form plasmodium.

Superfamily CERATIOMYXACEA McBride, 1892, *nom. correct.*

Superfamily Ceratiomyxacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Ceratiomyxioidea Pavillard, 1953].
Cohors Exosporeae ROSTAFINSKI, 1873, p. 2.
Class Exosporeae ROSTAFIŃSKIE, 1875, p. 83, 88.
Group Exosporeen ZOPF, 1885, p. 173.
Order Exosporea LANKESTER, 1885, p. 841.
Suborder Exosporei SCHROETER, 1886, p. 98, 100.
Subclass Exosporeae LISTER, 1894, p. 21, 25.
Order Ceratiomyxaceae A. LISTER, 1894, p. 21, 25.
Ectosporeae SCHROETER, 1897c, p. 15.
Order Exosporeae SEDGWICK, 1898, p. 17.
Exosporées TORREND, 1907, p. 37, 63 [*nom. neg.*].
Division Exosporeae J. J. LISTER *in* Lankester, 1909, p. 37.
Suborder Exosporeae DOFLEIN, 1911, p. 683.
Section Ectosporeae MINCHIN, 1912, p. 242.
Subsuborder Exosporinei POCHE, 1913, p. 200.
Series Exosporales E. JAHN *in* Engler & Prantl, 1928, p. 314.
Tribe Exosporeae KUDO, 1931, p. 187.
Subclass Exosporae MARTIN *in* Ainsworth & Bisby, 1950, p. 411.
Order Ceratiomyxales COOKE, 1951, p. 173.
Suborder Exosporés PAVILLARD *in* Grassé, 1953, p. 532.
Superfamily Ceratiomyxioidea PAVILLARD *in* Grassé, 1953, p. 533 [*nom. transl. ex* family Ceratiomyxidae McBride, 1892].
Spores developed outside a sporophore.

Family CERATIOMYXIDAE McBride, 1892
Family Ceratiomyxidae DOFLEIN, 1909, p. 599 [*nom. correct. pro* family Ceratiomyxaceae McBride, 1892].
Tribe Ceratiaceae ROSTAFINSKI, 1873, p. 2 [*nom. nud.;* based on *Ceratium* Albertini & Schweinitz, 1805 = *Ceratiomyxa* Schroeter, 1889, not *Ceratium* Schrank, 1793, a dinoflagellate].
Family Ceratiaceae LUERSSEN, 1879, p. 41 [*nom. nud.; nom. transl. ex* tribe Ceratiaceae Rostafinski, 1873].
Family Ceratiacei SCHROETER, 1886, p. 98, 101 [*nom. nud., nom. correct. pro* family Ceratiaceae Luerssen, 1879].
Ceratieae DE BARY, 1887, p. 427.
Family Ceratiomyxaceae MCBRIDE, 1892, p. 113 [*nom. subst. pro* family Ceratiaceae Luerssen, 1879, *nom. nud.*].
Family Ceratiacées VAN TIEGHEM, 1898, p. 20 [*nom. neg.*].
Family Ceratiomyxacées TORREND, 1907, p. 37, 39, 43, 63 [*nom. neg.*].
Family Ceratiomyxacea COPELAND, 1956, p. 177 [*nom. neg.*].
Sporophores membranous, branched; spores white, borne singly on filiform stalks arising from an areolated sporophore.

Superfamily STEMONITACEA Fries, 1829, *nom. correct.*

Superfamily Stemonitacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Stemonitidides Poche, 1913].
Cohors Endosporeae ROSTAFINSKI, 1873, p. 2 (*partim*).
Class Endosporeae ROSTAFIŃSKIE, 1875, p. 83, 89 (*partim*).
Trichophorae ROSTAFIŃSKIE, 1875, p. 83, 86, 91, 240 (*partim*).
Atrichae ROSTAFIŃSKIE, 1875, p. 83, 86, 90, 217 (*partim*).
Subclass Amaurosporeae ROSTAFIŃSKIE, 1875, p. 83, 90.
Group Endosporeen ZOPF, 1885, p. 136 (*partim*) [*nom. neg.*].
Order Endotricheen ZOPF, 1885, p. 143 (*partim*) [*nom. neg.*].
Suborder Stereonemeen ZOPF, 1885, p. 143 [*nom. neg.*].
Order Endosporea LANKESTER, 1885, p. 840 (*partim*).
Suborder Endotrichea LANKESTER, 1885, p. 841 (*partim*).

Amaurosporei SCHROETER, 1886, p. 103 (*partim*).

Suborder Endosporei SCHROETER, 1886, p. 98, 101 (*partim*).

Order Amaurosporae BERLESE *in* Saccardo, 1888, p. 323.

Cohort Amaurosporales A. LISTER, 1894, p. 21, 26.

Subclass Endosporeae A. LISTER, 1894, p. 21, 26 (*partim*).

Order Euplasmodiés DELAGE & HÉROUARD, 1896, p. 77, 83 [*nom. neg.*].

Order Euplasmodida DELAGE & HÉROUARD, 1896, p. 77, 83.

Order Endosporeae SEDGWICK, 1898, p. 17 (*partim*).

Amaurosporées TORREND, 1907, p. 38 [*nom. neg.*].

Atrichées TORREND, 1907, p. 37, 39 (*partim*) [*nom. neg.*].

Endosporées TORREND, 1907, p. 37 (*partim*) [*nom. neg.*].

Division Endosporeae J. J. LISTER *in* Lankester, 1909, p. 37 (*partim*).

Legion Amaurosporales DOFLEIN, 1911, p. 685.

Section Endosporeae MINCHIN, 1912, p. 242 (*partim*).

Subsuborder Endosporinei POCHE, 1913, p. 200 (*partim*).

Tribe Trichophorae POCHE, 1913, p. 201 [*nom. nud.*].

Superfamily Amaurochaetides POCHE, 1913, p. 202 [*nom. transl. ex* tribe Amaurochaetaceae Rostafinski, 1873].

Superfamily Stemonitidides POCHE, 1913, p. 202 [*nom. transl. ex* family Stemonitei Fries, 1829].

Order Amaurosporales A. LISTER & G. LISTER, 1925, p. 1.

Endosporeae (Myxogastres) FITZPATRICK, 1930, p. 2 (*partim*).

Tribe Endosporeae KUDO, 1931, p. 187 (*partim*).

Suborder Endosporées PAVILLARD *in* Grassé, 1953, p. 532 (*partim*) [*nom. neg.*].

Superfamily Stemonitioidea PAVILLARD *in* Grassé, 1953, p. 533 [*nom. correct. pro* superfamily Stemonitidides Poche, 1913].

Spores violet brown or purplish gray and developed in a sporangium.

Family PHYSARIDAE Fries, 1829

Family Physaridae DOFLEIN, 1909, p. 601 [*nom. correct. pro* family Physarei Fries, 1829].

Family Aethalini FRIES, 1829, p. 74.

Family Physarei FRIES, 1829, p. 75.

Physareen DE BARY, 1864, p. 3 [*nom. neg.*].

Order Calcareae ROSTAFINSKI, 1873, p. 9.

Tribe Spumariaceae ROSTAFINSKI, 1873, p. 13.

Tribe Didymiaceae ROSTAFINSKI, 1873, p. 12.

Tribe Physaraceae ROSTAFINSKI, 1873, p. 9.

Tribe Cienkowskiaceae ROSTAFINSKI, 1873, p. 9.

Family Cienkowskiaceae ROSTAFIŃSKIE, 1875, p. 49, 84, 91 [*nom. transl. ex* tribe Cienkowskiaceae Rostafinski, 1873].

Family Physaraceae ROSTAFIŃSKIE, 1875, p. 50, 84, 92 [*nom. correct. pro* family Physarei Fries, 1829].

Family Didymiaceae ROSTAFIŃSKIE, 1875, p. 53, 84, 149 [*nom. transl. ex* tribe Didymiaceae Rostafinski, 1873].

Family Spumariaceae ROSTAFIŃSKIE, 1875, p. 59, 84, 189 [*nom. transl. ex* tribe Spumariaceae Rostafinski, 1873].

Family Didymiaceen ZOPF, 1885, p. 150 [*nom. neg.*].

Family Physareen ZOPF, 1885, p. 144 [*nom. neg.*].

Family Spumariaceen ZOPF, 1885, p. 152 [*nom. neg.*].

Calcariaceen ZOPF, 1885, p. 143 [*nom. neg.*].

Family Physarea LANKESTER, 1885, p. 841 [*nom. correct. pro* family Physarei Fries, 1829].

Family Physaracei SCHROETER, 1886, p. 99, 120 [*nom. correct. pro* family Physarei Fries, 1829].

Physareae DE BARY, 1887, p. 424, 431.

Order Lithodermeae MASSEE, 1892, p. 30, 195, 197.

Suborder Didymeae MASSEE, 1892, p. 30, 197.

Suborder Physarae MASSEE, 1892, p. 30, 197, 262.

Order Didymiaceae A. LISTER, 1894, p. 21, 93.

Subcohort Calcarineae A. LISTER, 1894, p. 21, 26.

Order Physaraceae A. LISTER, 1894, p. 21, 26.

Tribe Physarées VAN TIEGHEM, 1898, p. 20 [*nom. neg.*].

Tribe Didymiées VAN TIEGHEM, 1898, p. 20 [*nom. neg.*].

Subcohort Calcarinae PENZIG, 1898, p. 16.

Family Physareae MACBRIDE, 1899, p. 21 [*nom. correct. pro* family Physarei Fries, 1829].

Family Didymieae MACBRIDE, 1899, p. 21, 82 [*nom. correct. pro* family Didymiaceae Rostafińskie, 1875].

Calcarinées TORREND, 1907, p. 37, 38 [*nom. neg.*].

Family Physaracées TORREND, 1907, p. 38, 42, 52 [*nom. neg.*].

Family Didymiacées TORREND, 1907, p. 38, 42, 51 [*nom. neg.*].

Family Didymidae DOFLEIN, 1909, p. 601 [*nom. correct. pro* family Didymiaceae Rostafińskie, 1875].

Sublegion Calcarineae DOFLEIN, 1911, p. 685.

Subtribe Physaroinae POCHE, 1913, p. 202 [*nom. transl. ex* family Physarei Fries, 1829].

Family Didymiidae POCHE, 1913, p. 202 [*nom. correct. pro* family Didymidae Doflein, 1909].

Order Physarales MACBRIDE, 1922, p. 22.

Suborder Calcarineae A. LISTER & G. LISTER, 1925, p. 1.

Sublegion Calcarinea KUDO, 1931, p. 187.

Suborder Physariineae HAGELSTEIN, 1944, p. 9.

Suborder Physarina T. L. JAHN & F. F. JAHN, 1949, p. 138.

Superfamily Physaroidea PAVILLARD *in* Grassé, 1953, p. 533 [*nom. transl. ex* family Physarei Fries, 1829].

Family Didymiacea COPELAND, 1956, p. 177 [*nom. van.*].

Sporangia containing secreted calcium carbonate.

Subfamily PHYSARINAE Fries, 1829, *nom. correct.*

Subfamily Physarinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Physarei Schroeter, 1886].

Subfamily Physarei SCHROETER, 1886, p. 125 [*nom. transl. ex* family Physarei Fries, 1829].

Sporangia with lime in the form of minute round granules.

Subfamily DIDYMIINAE Rostafinski, 1873, *nom. correct.*

Subfamily Didymiinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Didymiei Schroeter, 1886].

Subfamily Didymiei SCHROETER, 1886, p. 99, 121 [*nom. transl. ex* tribe Didymiaceae Rostafinski, 1873].

Subfamily Spumariei SCHROETER, 1886, p. 99 [*nom. transl. ex* tribe Spumariaceae Rostafinski, 1873].

Lime deposited in crystals outside the sporangium wall.

Family STEMONITIDAE Fries, 1829

Family Stemonitidae DOFLEIN, 1909, p. 601 [*nom. correct. pro* family Stemonitei Fries, 1829].

Family Stemonitei FRIES, 1829, p. 75.

Stemoniteen DE BARY, 1864, p. xi [*nom. neg.*].

Order Amaurochaeteae ROSTAFINSKI, 1873, p. 6.

Tribe Amaurochaetaceae ROSTAFINSKI, 1873, p. 8.

Tribe Stemonitaceae ROSTAFINSKI, 1873, p. 6.

Tribe Echinosteliaceae ROSTAFINSKI, 1873, p. 7.

Tribe Enerthenemaceae ROSTAFINSKI, 1873, p. 8.

Tribe Brefeldiaceae ROSTAFINSKI, 1873, p. 8.

Family Stemonitaceae ROSTAFIŃSKIE, 1875, p. 38, 85, 193 [*nom. transl. ex* tribe Stemonitaceae Rostafinski, 1873].

Family Enerthenemaceae ROSTAFIŃSKIE, 1875, p. 43, 85, 203 [*nom. transl. ex* tribe Enerthenemaceae Rostafinski, 1873].

Family Echinosteliaceae ROSTAFIŃSKIE, 1875, p. 44, 85, 215 [*nom. transl. ex* tribe Echinosteliaceae Rostafinski, 1873].

Family Brefeldiaceae ROSTAFIŃSKIE, 1875, p. 44, 86, 212 [*nom. transl. ex* tribe Brefeldiaceae Rostafinski, 1873].

Order Amaurochaete ROSTAFIŃSKIE, 1875, p. 7.

Family Amaurochaetaceae ROSTAFIŃSKIE, 1875, p. 46, 85, 210 [*nom. transl. ex* tribe Amaurochaetaceae Rostafinski, 1873].

Family Stemonitaceaee ROSTAFIŃSKIE, 1876 p. 24 [*nom. null.*].

Amaurochaetaceen ZOPF, 1885, p. 154 [*nom. neg.*].

Family Stemoniteen ZOPF, 1885, p. 154 [*nom. neg.*].

Family Enerthenemeen ZOPF, 1885, p. 157 [*nom. neg.*].

Family Enerthenemea LANKESTER, 1885, p. 841. [*nom. correct. pro* family Enerthenemaceae Rostafińskie, 1875].

Family Stemonitea LANKESTER, 1885, p. 841 [*nom. correct. pro* family Stemonitei Fries, 1829].

Family Stemonitacei SCHROETER, 1886, p. 99 [*nom. correct. pro* family Stemonitei Fries, 1829].

Stemoniteae DE BARY, 1887, p. 427.

Family Raciborskiaceae BERLESE *in* Saccardo, 1888, p. 324, 400.

Order Amaurocheteae BERLESE *in* Saccardo, 1888, p. 389.

Suborder Lamprodermae MASSEE, 1892, p. 30, 71, 94.

Suborder Stemonitae MASSEE, 1892, p. 30, 71, 72.

Order Stemonitaceae A. LISTER, 1894, p. 21, 108.

Subcohort Amaurochaetineae A. LISTER, 1894, p. 21, 108.

Order Amaurochaetaceae A. LISTER, 1894, p. 22, 134.

Leptonemeae SCHRÖTER, 1897c, p. 15.

Subcohort Amaurochaetinae PENZIG, 1898, p. 51.

Tribe Stemonitées VAN TIEGHEM, 1898, p. 20 [*nom. neg.*].

Family Lamprodermeae MACBRIDE, 1899, p. 107, 136.

Family Amaurochaeteae MACBRIDE, 1899, p. 107 [*nom. correct. pro* family Amaurochaetaceae Rostafińskie, 1875].

Order Columelliferae MORGAN, 1900, p. 128 [*non* order Columelliferae Rostafińskie, 1876].

Order Leptoneminées TORREND, 1907, p. 38 [*nom. neg.*].

Order Acalcarinées TORREND, 1907, p. 37, 38 [*nom. neg.*].

Family Brefeldiacées TORREND, 1907, p. 38, 41, 49 [*nom. neg.*].

Family Stemonitacées TORREND, 1907, p. 38, 41, 49 [*nom. neg.*].

Subcohort Amaurochaetineae J. J. LISTER *in* Lankester, 1909, p. 37.

Family Amaurochaetidae DOFLEIN, 1909, p. 601 [*nom. correct. pro* family Amaurochaeteae Macbride, 1899].

Sublegion Amaurochaetineae DOFLEIN, 1911, p. 685.

Subtribe Amaurochaetoinae POCHE, 1913, p. 201 [*nom. transl. ex* tribe Amaurochaetaceae Rostafinski, 1873].

Family Brefeldiidae POCHE, 1913, p. 202 [*nom. correct. pro* family Brefeldiaceae Rostafińskie, 1875].

Order Collodermaceae G. LISTER, 1918, p. 39.

Order Stemonitales MACBRIDE, 1922, p. 22, 148.

Family Lamprodermaceae MACBRIDE, 1922, p. 148, 189 [*nom. correct. pro* family Lamprodermeae Macbride, 1899].

Suborder Amaurochaetineae A. LISTER & G. LISTER, 1925, p. 2.

Family Collodermaceae A. LISTER & G. LISTER, 1925, p. 2.

Family Amaurochaetacées POUCHET, 1925, p. 55 [*nom. neg.*].

Sublegion Amaurochaetinea KUDO, 1931, p. 187.

Family Elaeomyxaceae HAGELSTEIN, 1942, p. 594.

Order Amaurochaetales HAGELSTEIN, 1944, p. 9.

Family Collodermataceae HAGELSTEIN, 1944, p. 10 [*nom. van. pro* family Collodermaceae Lister & Lister, 1925].

Family Stemonitidaceae HAGELSTEIN, 1944, p. 10 [*nom. van. pro* family Stemonitaceae Rostafińskie, 1875].

Suborder Stemonitina T. L. JAHN & F. F. JAHN, 1949, p. 139.

Family Echinosteliidae PAVILLARD *in* Grassé 1953, p. 533 [*nom. correct. pro* family Echinosteliaceae Rostafińskie, 1875].

Family Amaurochaetacea COPELAND, 1956, p. 175 [*nom. van.*].

Sporangia without lime deposits.

Subfamily COLLODERMINAE Lister & Lister, 1925, *nom. transl.*

Subfamily Collodermínae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Collodermaceae Lister & Lister, 1925].

Sporangia distinct, sessile, with gelatinous outer wall.

Subfamily STEMONITINAE Fries, 1829, *nom. correct.*

Subfamily Stemonitinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Stemonitei Schroeter, 1886].

Subfamily Stemonitei SCHROETER, 1886, p. 116 [*nom. transl. ex* family Stemonitei Fries, 1829].

Subfamily Brefeldiei SCHROETER, 1886, p. 119 [*nom. transl. ex* tribe Brefeldiaceae Rostafinski, 1873].

Sporangia distinct, commonly with stalk and columella.

Subfamily AMAUROCHAETINAE Rostafinski, 1873, *nom. transl.*

Subfamily Amaurochaetinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* tribe Amaurochaetaceae Rostafinski, 1873].

Sporangia combined to form an aethalium.

Superfamily TRICHIACEA Fries, 1821, *nom. correct.*

Superfamily Trichiacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Trichiides Poche, 1913].

Family Fuliginoidei FRIES, 1821, p. xlix, 1 [*nom. nud.*].

Cohors Endosporeae ROSTAFINSKI, 1873, p. 2 (*partim*).

Order Anemeae ROSTAFINSKI, 1873, p. 4.

Order Calonemeae ROSTAFINSKI, 1873, p. 14.

Order Enteridieae ROSTAFINSKI, 1873, p. 3.

Class Endosporeae ROSTAFIŃSKIE, 1875, p. 83, 89 (*partim*).

Trichophorae ROSTAFIŃSKIE, 1875, p. 83, 86, 91, 240 (*partim*).

Atriche ROSTAFIŃSKIE, 1875, p. 83, 86, 90, 217 (*partim*).

Subclass Lamprosporeae ROSTAFIŃSKIE, 1875, p. 83, 217.

Order Entheridieae ROSTAFINSKIE, 1875, p. 7, 29.

Suborder Coelonemeen ZOPF, 1885, p. 159 [*nom. neg.*].

Group Endosporeen ZOPF, 1885, p. 136 (*partim*) [*nom. neg.*].

Order Endotricheen ZOPF, 1885, p. 143 (*partim*) [*nom. neg.*].

Order Peritricheen ZOPF, 1885, p. 137 [*nom. neg.*].

Order Endosporea LANKESTER, 1885, p. 840.

Suborder Endotrichea LANKESTER, 1885, p. 841.

Suborder Peritrichea LANKESTER, 1885, p. 841.

Suborder Endosporei SCHROETER, 1886, p. 98, 101 (*partim*).

Lamprosporei SCHROETER, 1886, p. 102.

Lamprosporae BERLESE *in* Saccardo, 1888, p. 324, 404.

Order Calotricheae MASSEE, 1892, p. 30, 111, 112.

Order Peritricheae MASSEE, 1892, p. 30, 32.

Subclass Endosporeae A. LISTER, 1894, p. 21, 26 (*partim*).

Subcohort Anemineae A. LISTER, 1894, p. 22, 136.

Cohort Lamprosporales A. LISTER, 1894, p. 22, 136.

Subcohort Calonemineae A. LISTER, 1894, p. 22, 161.

Order Euplasmodiés DELAGE & HÉROUARD, 1896, p. 77, 83 (*partim*) [*nom. neg.*].

Order Euplasmodida DELAGE & HÉROUARD, 1896, p. 77, 83 (*partim*).

Platynemeae SCHRÖTER, 1897c, p. 15.

Order Endosporeae SEDGWICK, 1898, p. 17 (*partim*).

Calonemata MORGAN, 1900, p. 126.

Endosporées TORREND, 1907, p. 37 (*partim*) [*nom. neg.*].

Atrichées TORREND, 1907, p. 37, 39 (*partim*) [*nom. neg.*].

Platyneminées TORREND, 1907, p. 38, 39 [*nom. neg.*].

Lamprosporées TORREND, 1907, p. 38 [*nom. neg.*].

Caloneminées TORREND, 1907, p. 38, 39 [*nom. neg.*].

Division Endosporeae J. J. LISTER *in* Lankester, 1909, p. 37 (*partim*).

Legion Lamprosacrales DOFLEIN, 1911, p. 685.

Sublegion Aneminea DOFLEIN, 1911, p. 685.

Sublegion Calonemineae DOFLEIN, 1911, p. 686.

Section Endosporeae MINCHIN, 1912, p. 242 (*partim*).

Subsuborder Endosporinei POCHE, 1913, p. 200 (*partim*).

Tribe Atrichae POCHE, 1913, p. 200 [*nom. nud.*].

Superfamily Trichiides POCHE, 1913, p. 201 [*nom. transl. ex* family Trichocisti (Trichioidei) Fries, 1821].

Suborder Anemineae A. LISTER & G. LISTER, 1925, p. 2.

Order Lamprosporales A. LISTER & G. LISTER, 1925, p. 2.

Suborder Calonemineae A. LISTER & G. LISTER, 1925, p. 3.

Order Enteridiales E. JAHN, 1928, p. 16.

Legion Lamprosporales DOFLEIN & REICHENOW, 1929, p. 841.

Endosporeae (Myxogastres) FITZPATRICK, 1930, p. 2 (*partim*).

Tribe Endosporeae KUDO, 1931, p. 187 (*partim*) [*nom. nud.*].

Sublegion Caloneminea KUDO, 1931, p. 187.

Suborder Calonematineae HAGELSTEIN, 1944, p. 11.

Suborder Dictydiineae HAGELSTEIN, 1944, p. 10.

Suborder Endosporées PAVILLARD *in* Grassé, 1953, p. 532 (*partim*) [*nom. neg.*].

Superfamily Enteridioidea PAVILLARD *in* Grassé, 1953, p. 533.

Superfamily Trichioidea PAVILLARD *in* Grassé, 1953, p. 533 [*nom. correct. pro* superfamily Trichiides Poche, 1913].

Superfamily Margaritoidea PAVILLARD *in* Grassé, 1953, p. 533 [*nom. transl. ex* family Margaritidae Doflein, 1909].

Variously colored spores, but generally not violet brown or purplish gray, developed in a sporangium.

Family LICEIDAE Fries, 1821

Family Liceidae DOFLEIN, 1909, p. 601 [*nom. correct. pro* family Liceoidei Fries, 1821].

Family Liceoidei FRIES, 1821, p. xlix, 1.

Lycogaleen DE BARY, 1864, p. xi [*nom. neg.*].

Tribe Liceaceae ROSTAFINSKI, 1873, p. 4 [*nom. transl. ex* family Liceoidei Fries, 1821].

Tribe Cribrariaceae ROSTAFINSKI, 1873, p. 5.

Order Heterodermeae ROSTAFINSKI, 1873, p. 5.

Tribe Liceathaliaceae ROSTAFINSKI, 1873, p. 4.

Order Reticularieae ROSTAFINSKI, 1873, p. 6 [*non* Order Reticularia Carpenter, Parker & Jones, 1862, foraminifera].

Tribe Reticulariaceae ROSTAFINSKI, 1873, p. 6.

Tribe Lycogalaceae ROSTAFINSKI, 1873, p. 3.

Tribe Dictydiaethaliaceae ROSTAFINSKI, 1873, p. 5.

Family Liceaceae ROSTAFIŃSKIE, 1875, p. 32, 86, 218 [*nom. transl. ex* tribe Liceaceae Rostafinski, 1873].

Family Cribrariaceae ROSTAFINSKIE, 1875, p. 35, 229 [*nom. transl. ex* tribe Cribrariaceae Rostafinski, 1873].

Family Liceathaliaceae ROSTAFINSKIE, 1875 p. 33 [*nom. transl. ex* tribe Liceathaliaceae Rostafinski, 1873].

Family Reticulariaceae ROSTAFINSKIE, 1875 p. 86, 240 [*nom. transl. ex* tribe Reticulariaceae Rostafinski, 1873].

Family Clathroptychiaceae ROSTAFIŃSKIE, 1875, p. 38, 86, 224.

Family Protodermaceae ROSTAFIŃSKIE, 1875, p. 90.

Order Protodermeae ROSTAFINSKIE, 1875, p. 61, 83, 90.

Order Columelliferae ROSTAFIŃSKIE, 1876, p. 32.

Family Dictydiaethaliaceae LUERSSEN, 1879, p. 43 [*nom. transl. ex* tribe Dictydiaethaliaceae Rostafinski, 1873].

Family Lycogalaceae LUERSSEN, 1879, p. 41 [*nom. transl. ex* tribe Lycogalaceae Rostafinski, 1873].

Family Reticulariaceen ZOPF, 1885, p. 158 [*nom. neg.*].

Family Liceaceen ZOPF, 1885, p. 171 [*nom. neg.*].

Family Cribrariaceen ZOPF, 1885, p. 139 [*nom. neg.*].

Family Clathroptychiaceen ZOPF, 1885, p. 137 [*nom. neg.*].

Family Liceacei SCHROETER, 1886, p. 98, 102 [*nom. correct. pro* family Liceoidei Fries, 1821].

Family Cribrariacei SCHROETER, 1886, p. 98, 102 [*nom. correct. pro* family Cribrariaceae Rostafińskie, 1875].

Family Reticulariacei SCHROETER, 1886, p. 99, 115 [*nom. correct. pro* family Reticulariaceae Rostafińskie, 1875].

Family Clathroptychiacei SCHROETER, 1886, p. 98, 108 [*nom. correct. pro* family Clathroptychiaceae Rostafińskie, 1875].

Cribrarieae DE BARY, 1887, p. 421.

Tubulinae DE BARY, 1887, p. 421.

Order Protodermieae BERLESE *in* Saccardo, 1888, p. 328.

Family Protodermiaceae BERLESE *in* Saccardo, 1888, p. 323 [*nom. van. pro* family Protodermaceae Rostafiński, 1875].

Family Orcadellaceae WINGATE, 1889, p. 280.

Order Cribrariae MASSEE, 1892, p. 30, 34, 44.

Suborder Tubulinae MASSEE, 1892, p. 30, 34, 35.

Order Reticulariaceae MORGAN, 1893, p. 10.

Order Heterodermaceae A. LISTER, 1894, p. 22, 136.

Order Tubulinaceae A. LISTER, 1894, p. 22, 152.

Order Lycogalaceae A. LISTER, 1894, p. 23, 207.

Tribe Tubulinées VAN TIEGHEM, 1898, p. 20 [*nom. neg.*].

Family Liceae MACBRIDE, 1899, p. 145 [*nom. correct. pro* family Liceoidei Fries, 1821].

Order Cribrariaceae MACBRIDE, 1899, p.145.

Family Cribrarieae MACBRIDE, 1899, p. 145, 159 [*nom. correct. pro* family Cribrariaceae Rostafiński, 1875].

Family Tubifereae MACBRIDE, 1899, p. 145, 153.

Family Reticularieae MACBRIDE, 1899, p. 145, 149 [*nom. correct. pro* family Reticulariaceae Rostafiński, 1875].

Family Orcadelleae MACBRIDE, 1899, p. 145, 158 [*nom. correct. pro* family Orcadellaceae Wingate, 1889].

Family Heterodermaceae R. E. FRIES, 1903, p. 67 [*nom. nud.*, not based on *Heteroderma* Fitzinger, 1843, rept.].

Family Tubulinaceae R. E. FRIES, 1903, p. 68 [based on *Tubulina* Persoon, 1794, a junior synonym of *Tubifera* Gmelin, 1791].

Family Dictydioethaliacées TORREND, 1907, p. 37, 39, 43 [*nom. neg.*].

Family Liceacées TORREND, 1907, p. 37, 39, 43 [*nom. neg.*].

Family Cribrariacées TORREND, 1907, p. 37, 43, 44 [*nom. neg.*].

Family Tubiferacées TORREND, 1907, p. 37, 40, 45 [*nom. neg.*].

Family Reticulariacées TORREND, 1907, p. 38, 41, 49 [*nom. neg.*].

Family Lycogalacées TORREND, 1907, p. 38, 40, 45 [*nom. neg.*].

Family Orcadellacées TORREND, 1907, p. 37, 39, 43 [*nom. neg.*].

Family Tubulinidae DOFLEIN, 1909, p. 601 [*nom. correct. pro* family Tubulinaceae R. E. Fries, 1903].

Family Lycogalidae DOFLEIN, 1909, p. 602 [*nom. correct. pro* family Lycogalaceae Luerssen, 1879].

Family Heterodermidae DOFLEIN, 1911, p. 686 [*nom. nud.*].

Family Reticulariidae DOFLEIN, 1911, p. 681, [*nom. correct. pro* family Reticulariaceae Rostafiński, 1875, not = Reticulariidae Calkins, 1909, *nom. nud.*, foraminifera].

Family Orcadellidae POCHE, 1913, p. 201 [*nom. correct. pro* family Orcadellaceae Wingate, 1889].

Family Lycogalactidae POCHE, 1913, p. 201 [*nom. van. pro* family Lycogalidae Doflein, 1909].

Family Cribrariidae POCHE, 1913, p. 201 [*nom. correct. pro* family Cribrariaceae Rostafiński, 1875].

Family Dictydiaethaliidae POCHE, 1913, p. 201 [*nom. correct. pro* family Dictydiaethaliaceae Luerssen, 1879].

Family Tubiferidae POCHE, 1913, p. 201 [*nom. correct. pro* family Tubifereae Macbride, 1899].

Family Liceacae MACBRIDE, 1922, p. 199 [*nom. null.*].

Order Cribriariales MACBRIDE, 1922, p. 22, 199.

Family Tubiferaceae MACBRIDE, 1922, p. 199, 203 [*nom. correct. pro* family Tubifereae Macbride, 1899].

Order Lycogalales MACBRIDE, 1922, p. 22, 232.

Family Heterodermacées POUCHET, 1925, p. 56 [*nom. neg.*, *nom. nud.*].

Family Tubulinacées POUCHET, 1925, p. 57 [*nom. neg.*].

Order Liceales E. JAHN, 1928, p. 16.

Order Cribriariales PLUNKETT, 1934, p. 44 [*nom. null.*].

Suborder Liceina T. L. JAHN & F. F. JAHN, 1949, p. 140.

Family Liceidae PAVILLARD *in* Grassé, 1953, p. 533 [*nom. correct. pro* family Liceoidei Fries, 1821].

Superfamily Liceoidea PAVILLARD *in* Grassé, 1953, p. 533 [*nom. transl. ex* family Liceoidei Fries, 1821].

Superfamily Cribrarioidea PAVILLARD *in* Grassé, 1953, p. 533 [*nom. transl. ex* tribe Cribrariaceae Rostafinski, 1873].
Family Liceacea COPELAND, 1956, p. 175 [*nom. van.*].
Family Cribrariacea COPELAND, 1956, p. 175 [*nom. van*].
Family Reticulariacea COPELAND, 1956, p. 175 [*nom. van.*].
Family Tubiferida COPELAND, 1956, p. 175 [*nom. van.*].
Family Lycogalactida COPELAND, 1956, p. 175 [*nom. van.*].

Capillitium lacking or not forming a system of uniform threads.

Subfamily CRIBRARIINAE Rostafinski, 1873, *nom. transl.*

Subfamily Cribrariinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* tribe Cribrariaceae Rostafinski, 1873].

Capillitium absent, or not forming system of uniform threads; sporangium wall membranous, with minute round granules.

Subfamily LICEINAE Fries, 1821, *nom. transl.*

Subfamily Liceinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Liceoidei Fries 1821].

Sporangia solitary, stalked, sporangium wall cartilaginous or membranous, capillitium absent.

Subfamily TUBIFERINAE Macbride, 1899, *nom. transl.*

Subfamily Tubiferinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Tubifereae Macbride, 1899].

Capillitium absent, sporangium wall membranous, without granular deposits, sporangia clustered, cylindrical or ellipsoidal.

Subfamily RETICULARIINAE Rostafinski, 1873, *nom. transl.*

Subfamily Reticulariinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* tribe Reticulariaceae Rostafinski, 1873].

Sporangia closely compacted, generally fused to form large bodies (aethalia), sporangium walls incomplete and perforated; no true capillitium, or may have a few branching strands.

Subfamily LYCOGALINAE Rostafinski, 1873, *nom. transl.*

Subfamily Lycogalinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* tribe Lycogalaceae Rostafinski, 1873].

Sporangia forming an aethalium, pseudocapillitium consisting of branched colorless tubes.

Family TRICHIIDAE Fries, 1821

Family Trichiidae DOFLEIN, 1909, p. 602 [*nom. correct. pro* family Trichocisti (Trichioidei) Fries, 1821].
Family Trichocisti (Trichioidei) FRIES, 1821, p. 1.
Family Trichiacei FRIES, 1829, p. 76.
Trichiaceen DE BARY, 1864, p. 18 [*nom. neg.*].
Tribe Trichiaceae ROSTAFINSKI, 1873, p. 14.
Tribe Perichaenaceae ROSTAFINSKI, 1873, p. 15.
Tribe Arcyriaceae ROSTAFINSKI, 1873, p. 15.
Family Arcyriaceae ROSTAFIŃSKIE, 1875, p. 70, 87, 267 [*nom. transl. ex* tribe Arcyriaceae Rostafinski, 1873].
Family Trichiaceae ROSTAFIŃSKIE, 1875, p. 62, 87, 243 [*nom. transl. ex* tribe Trichiaceae Rostafinski, 1873.]
Family Perichaenaceae ROSTAFINSKIE 1875, p. 73, 87, 291 [*nom. transl. ex* tribe Perichaenaceae Rostafinski, 1873].
Family Arcyriaceen ZOPF, 1885, p. 162 [*nom. neg.*].
Family Trichiaceen ZOPF, 1885, p. 159 [*nom. neg.*].
Family Perichaenaceen ZOPF, 1885, p. 169 [*nom. neg.*].
Family Trichinacea LANKESTER, 1885, p. 841 [*nom. correct. pro* family Trichocisti (Trichioidei) Fries, 1821].
Family Trichiacei SCHROETER, 1886, p. 98, 107 [*nom. correct. pro* family Trichocisti (Trichioidei) Fries, 1821].
Trichiae DE BARY, 1887, p. 436.
Arcyriae DE BARY, 1887, p. 436.
Suborder Arcyriae MASSEE, 1892, p. 30, 113.
Suborder Tricheae MASSEE, 1892, p. 30, 112.
Order Arcyriaceae MORGAN, 1893, p. 23.
Order Perichaenaceae MORGAN, 1893, p. 19.
Order Trichiaceae MORGAN, 1893, p. 28.
Order Margaritaceae A. LISTER, 1894, p. 23, 202.
Family Trichiacées VAN TIEGHEM, 1898, p. 15 [*nom. neg.*].

Tribe Trichiées VAN TIEGHEM, 1898, p. 20 [*nom. neg.*].

Family Dianemeae MACBRIDE, 1899, p. 179, 180 [*nom. nud.*, based on *Dianema* Rex, 1891 (=*Dianemina nom. nov.*), not *Dianema* Cope, 1871 (Pisces)].

Family Trichieae MACBRIDE, 1899, p. 179, 200 [*nom. correct. pro* family Trichocisti (Trichioidei) Fries, 1821].

Family Perichaeneae MACBRIDE, 1899, p. 179, 180 [*nom. correct. pro* family Perichaenaceae Rostafińskie, 1875].

Family Prototrichieae MACBRIDE, 1899, p. 179, 199.

Family Arcyrieae MACBRIDE, 1899, p. 179, 186 [*nom. correct. pro* family Arcyriaceae Rostafińskie, 1875].

Family Margaritacées TORREND, 1907, p. 38, 40, 45 [*nom. neg.*].

Family Arcyriacées TORREND, 1907, p. 38, 40, 45 [*nom. neg.*].

Family Margaritidae DOFLEIN, 1909, p. 602.

Family Arcyriidae DOFLEIN, 1909, p. 602 [*nom. correct. pro* family Arcyriaceae Rostafińskie, 1875].

Order Trichiales MACBRIDE, 1922, p. 22, 236.

Family Prototrichiaceae MACBRIDE, 1922, p. 237, 258 [*nom. correct. pro* family Prototrichieae Macbride, 1899].

Family Dianemaceae MACBRIDE, 1922, p. 237 [*nom. correct. pro* family Dianemeae Macbride, 1899; *nom. nud.*].

Family Margaritaceae A. LISTER & G. LISTER, 1925, p. 3 [*nom. correct. pro* family Margaritidae Doflein, 1909].

Family Arcyriacées POUCHET, 1925, p. 61 [*nom. neg.*].

Order Margaritales E. JAHN, 1928, p. 16.

Family Listerellaceae E. JAHN, 1928, p. 16.

Family Trichiacea COPELAND, 1956, p. 176 [*nom. van.*].

Family Margaritida COPELAND, 1956, p. 176 [*nom. van.*].

Family Perichaenacea COPELAND, 1956, p. 176 [*nom. van.*].

Family Arcyriacea COPELAND, 1956, p. 176 [*nom. van.*].

Capillitium present as a system of uniform or sculptured threads.

Subfamily TRICHIINAE Fries, 1821, *nom. correct.*

Subfamily Trichiinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Trichiei Schroeter, 1886].

Subfamily Trichiei SCHROETER, 1886, p. 99, 111 [*nom. transl. ex* family Trichocisti (Trichioidei) Fries, 1821].

Subfamily Trichieae MCBRIDE, 1892, p. 120, 128 [*nom. correct. pro* subfamily Trichiei Schroeter, 1886].

Capillitium distinct, consisting of a system of tubular threads, either free and unbranched, or with an open network, with spiral or annular thickenings.

Subfamily ARCYRIINAE Rostafinski, 1873, *nom. correct.*

Subfamily Arcyriinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Arcyriei Schroeter, 1886].

Subfamily Arcyriei SCHROETER, 1886, p. 99 [*nom. transl. ex* tribe Arcyriaceae Rostafinski, 1873].

Subfamily Perichaenei SCHROETER, 1886, p. 98, 107 [*nom. transl. ex* tribe Perichaenaceae Rostafinski, 1873].

Subfamily Arcyrieae MCBRIDE, 1892, p. 120, 121 [*nom. correct. pro* subfamily Arcyriei Schroeter, 1886].

Subfamily Perichaeneae MCBRIDE, 1892, p. 120 [*nom. correct. pro* subfamily Perichaenei Schroeter, 1886].

Capillitium combined into an elastic network of tubular threads branching at wide angles, the threads smooth or with thickenings in the form of cogs, rings, half-rings, spines or warts, or more rarely with free threads forming a scanty network.

Subfamily DIANEMININAE Loeblich & Tappan, *subfam. nov.*

Subfamily Dianemininae LOEBLICH & TAPPAN, herein [*nom. subst.* and *nom. transl. ex* family Dianemeae Macbride, 1899; *nom. nud.*].

Capillitium abundant, of solid threads, coiled and hairlike or nearly straight and attached to the sporangium wall, simple or branching at acute angles. Sporangia normally sessile. Type genus: *Dianemina* Loeblich & Tappan, *nom. nov.*

Remarks.—*Dianemina nom. nov.* is proposed herein for *Dianema* Rex, 1891, Proc. Acad. Nat. Sci. Philadelphia, p. 397 (*non Dianema* Cope, 1871, pisces). Type species, *Dianemina harveyi* (Rex) = *Dianema harveyi* Rex, 1891.

Order ARCELLINIDA Kent, 1880

Order Arcellinida KENT, 1880, p. 36.
Order Monostega DIESING, 1848, p. 497 (*partim*).
Testacea SCHULTZE, 1854, p. 52 (preoccupied by Testacea in Mollusca).
Lepamoebae HAECKEL, 1870, p. 56 (*partim*).
Monothalamia monostomata HERTWIG & LESSER, 1874, p. 91.
Suborder Testacea BÜTSCHLI *in* Bronn, 1880, p. 181.
Order Testacea LANKESTER, 1885, p. 842.
Order Monostegia HAECKEL, 1894, p. 164 (*partim*).
Order Arcellina (Thecolobosa) HAECKEL, 1894, p. 164.
Order Thecamoebida DELAGE & HÉROUARD, 1896, p. 101.
Suborder Thecamoebina CALKINS, 1901, p. 106.
Order Conchulina CASH, 1904, p. 224 (*partim*).
Rhizopoda lobosa testacea SCHOUTEDEN, 1906, p. 329.
Section Testacea MINCHEN, 1912, p. 217.
Suborder Testacea (Thecamoebaea) RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 69.
Order Thecamoebaea (Testacea) KÜHN, 1926, p. 118.
Suborder Testacealobosa DE SAEDELEER, 1934, p. 5.
Order Testacida T. L. JAHN & F. F. JAHN, 1949, p. 42.
Order Testacealobosa DEFLANDRE *in* Grassé 1953, p. 123.
Order Lampramoebae COPELAND, 1956, p. 205.

With a test or rigid external membrane, and with definite aperture for extrusion of the lobose pseudopodia.

Superfamily ARCELLACEA Ehrenberg, 1843, *nom. transl.*

Superfamily Arcellacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Arcellina Ehrenberg, 1843].
Family group Polystomata RHUMBLER, 1928, p. 4 (*partim*) (*non* Polystomata Averintsev, 1906).
Legion Eulobosa DE SAEDELEER, 1934, p. 5, 11.
Suborder Eulobosa DEFLANDRE *in* Grassé, 1953, p. 123.

Pseudopodia fingerlike, not anastomosing.

Family COCHLIOPODIIDAE Taránek, 1882

Family Cochliopodiidae HICKSON *in* Lankester, 1909, p. 88 [*nom. correct. pro* family Cochliopodidae Taránek, 1882].
Family Cochliopodidae TARÁNEK, 1882a, p. 223.
Subfamily Pseudonebelinae WAILES *in* Cash, Wailes & Hopkinson, 1919, p. 66 [*nom. nud.*].
Subfamily Cochliopodiinae DE SAEDELEER, 1934, p. 11 [*nom. transl. ex* family Cochliopodidae Taránek, 1882].

Test reduced to a flexible or semirigid membrane, without definite aperture. Possibly intermediate between Amoebida and Arcellinida.

Family MICROCORYCIIDAE de Saedeleer, 1934

Family Microcoryciidae DEFLANDRE *in* Grassé, 1953, p. 125 [*nom. correct.* and *nom. transl. ex* subfamily Mikrocoryciinae de Saedeleer, 1934].
Subfamily Mikrocoryciinae DE SAEDELEER, 1934, p. 5, 18.
Tribus Mikrocoryciini DE SAEDELEER, 1934, p. 5, 18.
Tribus Microchlamyini DE SAEDELEER, 1934, p. 5, 18.

Membranous shell, in part rigid or semirigid, thinning and becoming more pliable toward the variously shaped aperture. One or many nuclei.

Family ARCELLIDAE Ehrenberg, 1843

Family Arcellidae SCHULZE, 1877, p. 26 [*nom. correct. pro* family Arcellina Ehrenberg, 1843].
Family Arcellina EHRENBERG, 1843, p. 336, 338.
Family Arcellinea DIESING, 1848, p. 495 [*nom. correct. pro* family Arcellina Ehrenberg, 1843].
Family Arcellineae DIESING, 1848, p. 497 [*nom. correct. pro* family Arcellina Ehrenberg, 1843].
Family Monothalamia PRITCHARD, 1861, p. 201 (*non* Monothalamia Schultze, 1854) [*nom. nud.*].
Family Arcellida CASH, 1904, p. 224 [*nom. correct. pro* family Arcellina Ehrenberg, 1843].
Subfamily Arcellinae WAILES, *in* Cash,

Wailes & Hopkinson, 1915, p. 13 [*nom. transl. ex* family Arcellina Ehrenberg, 1843].

Test chitinous, rigid, aperture ventral, always with edge infolded. Commonly with two nuclei, many have many, rarely only one.

Family CENTROPYXIDAE Jung, 1942

Family Centropyxidae JUNG, 1942a, p. 255.

Family Conchulina WAILES, 1927, p. 153 [*nom. nud.*].

Test chitinous, enclosing some foreign material, or with a sandy layer, generally with dorso-ventral symmetry. Aperture ventral, with recurved margin, excentric. One nucleus.

Family HYALOSPHENIIDAE Schulze, 1877

Family Hyalospheniidae JUNG, 1942a, p. 256 [*nom. correct. pro* family Hyalosphenidae Schulze, 1877].

Family Hyalosphenidae SCHULZE, 1877, p. 26.

Family Quadrulidae SCHULZE, 1877, p. 26 (based on *Quadrula* Schulze, 1875 = *Quadrulella* Cockerell, 1909; not *Quadrula* Rafinesque, 1820).

Family Nebelidae TARÁNEK, 1882a, p. 230.

Family Quadrulina (Euglyphina) HAECKEL, 1894, p. 164.

Subfamily Nebelina CASH & HOPKINSON, 1909, p. 80 [*nom. transl. ex* family Nebelidae Taránek, 1882].

Subfamily Nebelinae WAILES *in* Cash, Wailes & Hopkinson, 1919, p. 55 [*nom. correct. pro* subfamily Nebelina Cash & Hopkinson, 1909].

Subfamily Quadrulellinae DE SAEDELEER, 1934, p. 6 [*nom. subst.* for family Quadrulidae Schulze, 1877].

Family Heleoperidae JUNG, 1942a, p. 255.

Family Lecquereusiidae JUNG, 1942a, p. 257.

Tribus Nebelini JUNG, 1942b, p. 387 [*nom. transl. ex* family Nebelidae Taránek, 1882].

Tribus Physochilini JUNG, 1942b, p. 387.

Subfamily Heleoperinae JUNG, 1942b, p. 385 [*nom. transl. ex* family Heleoperidae Jung, 1942].

Subfamily Hyalospheniinae JUNG, 1942b, p. 385, 387 [*nom. transl. ex* family Hyalospheniidae Schulze, 1877].

Family Nebelida COPELAND, 1956, p. 205 [*nom. van.*].

Test chitinous, with siliceous plates or scales, rounded or angular, and may have foreign matter added; aperture elongated or rounded; one nucleus.

Family PARAQUADRULIDAE Deflandre, 1953, *nom. transl.*

Family Paraquadrulidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Paraquadrulinae Deflandre, 1953].

Subfamily Paraquadrulinae DEFLANDRE *in* Grassé, 1953, p. 130.

Test with quadrangular calcite plates covering a thin chitinous pellicle; aperture ovate; one nucleus.

Family DIFFLUGIIDAE Wallich, 1864

Family Difflugiidae TARÁNEK, 1882a, p. 225 [*nom. transl. ex* subfamily Difflugidae Wallich, 1864].

Subfamily Difflugidae WALLICH, 1864, p. 217, 240.

Family Difflugina HAECKEL, 1894, p. 164 [*nom. correct. pro* family Difflugiidae Taránek, 1882].

Family Adjungentiidae RHUMBLER, 1895a, p. 93, 95 (*partim*) [*nom. nud.*].

Family Protrudentiidae RHUMBLER, 1895a, p. 94, 95 (*partim*) [*nom. nud.*].

Subfamily Difflugina CASH & HOPKINSON, 1909, p. 2 [*nom. correct. pro* subfamily Difflugidae Wallich, 1864].

Subfamily Difflluginae WAILES *in* Cash, Wailes & Hopkinson, 1919, p. 36 [*nom. correct. pro* subfamily Difflugidae Wallich, 1864].

Subfamily Difflugiinae CALKINS, 1926, p. 340 [*nom. correct. pro* subfamily Difflugidae Wallich, 1864].

Family Difflugiidae (Lobosa) HOOGENRAAD & DE GROOT, 1940, p. 24.

Family Pontigulasiidae JUNG, 1942a, p. 257.

Subfamily Cingodifflugiinae JUNG, 1942b, p. 387, 388.

Subfamily Planodifflugiinae JUNG, 1942b, p. 388.

Family Difflugiida COPELAND, 1956, p. 205 [*nom. van*].

Test rarely chitinous, generally composed of foreign particles, not of secreted plates; form variable but with axial symmetry and terminal aperture. One or many nuclei.

Superfamily CRYPTODIFFLUGIACEA Jung, 1942, *nom. transl.*

Superfamily Cryptodifflugiacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Cryptodifflugiidae Jung, 1942].

Legio Reticulolobosa DE SAEDELEER, 1934, p. 6, 21.

Suborder Reticulolobosa DEFLANDRE *in* Grassé, 1953, p. 132.

Pseudopodia of ectoplasm, pointed or bifurcating, anastomosing.

Family CRYPTODIFFLUGIIDAE Jung, 1942

Family Cryptodifflugiidae JUNG, 1942a, p. 257.

Test chitinous.

Family PHRYGANELLIDAE Jung, 1942

Family Phryganellidae JUNG, 1942a, p. 257.

Test arenaceous.

Subclass FILOSIA Leidy, 1879, *nom. correct.* and *nom. transl.*

Subclass Filosia LOEBLICH & TAPPAN, herein [*nom. correct.* and *nom. transl. ex* suborder Filosa Leidy, 1879].

Rhizopoda asphycta HAECKEL, 1862, p. 211 (*partim*).

Protoplasta HAECKEL, 1870, p. 56 (*partim*).

Suborder Filosa LEIDY, 1879, p. 23, 189.

Order Protoplasta LEIDY, 1879, p. 23 (*partim*).

Monothalamia filosa TARÁNEK, 1882a, p. 232.

Section Filosa LANKESTER, 1885, p. 838 (*partim*).

Class Reticularia LANKESTER, 1885, p. 845 (*partim*).

Filosa monostomata AVERINTSEV, 1907, p. 100.

Filosa CHATTON, 1925, p. 76.

Order Filosa DE SAEDELEER, 1934, p. 6, 24.

Class Filosa DEFLANDRE *in* Grassé, 1953, p. 132.-

Pseudopodia filiform, tapering, branching and anastomosing. Protoplasmic movement by an active shearing or sliding between adjacent gel-like filaments moving in opposite directions in the same pseudopod, and in the absence of a plasmagel cortex (see Jahn & Rinaldi, 1959, p. 101).

Order ACONCHULINIDA de Saedeleer, 1934, *nom. correct.*

Order Aconchulinida LOEBLICH & TAPPAN, herein [*nom. correct. pro* order Aconchulina Deflandre, 1953].

Suborder Aconchulina DE SAEDELEER, 1934, p. 6, 24.

Order Aconchulina DEFLANDRE *in* Grassé, 1953, p. 92.

Naked amoebae with filiform pseudopodia.

Family PENARDIIDAE Loeblich & Tappan, *fam. nov.*

Family Reticulosa CASH, 1904, p. 222 (*partim*) [*non* Reticulosa Carpenter, Parker & Jones, 1862; *nom. nud.*].

Characters as in the order. Type genus: *Penardia* Cash, 1904.

Order GROMIDA Claparède & Lachmann, 1859

Order Gromida CLAPARÈDE & LACHMANN, 1859, p. 464.

Order Monostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxvii, 1 (*partim*) [*nom. neg.*].

Lepamoebae HAECKEL, 1870, p. 56 (*partim*).

Order Gromiidea LANKESTER, 1885, p. 845.

Subclass Imperforata LANKESTER, 1885, p. 845 (*partim*).

Suborder Gromidae DELAGE & HÉROUARD, 1896, p. 109.

Monostomata AVERINTSEV, 1906, p. 258.

Rhizopoda filosa testacea SCHOUTEDEN, 1906, p. 358.

Group Amphistomata SCHOUTEDEN, 1906, p. 372.

Order Solenopoda ZARNIK, 1908, p. 78.

Order Gromiida CALKINS, 1909, p. 38.

Suborder Testaceafilosa DE SAEDELEER, 1934, p. 6, 27.

Order Testaceafilosa DEFLANDRE *in* Grassé, 1953, p. 133.

Amoebae with filopodia, shell or lorica always with a distinct aperture. Uniflagellate gametes (*Gromia*).

Superfamily GROMIACEA Reuss, 1862, *nom. correct.*

Superfamily Gromiacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Gromiides Poche, 1913].

Foraminifera Monomera REUSS, 1862, p. 362 (*partim*) (*non* Monomera Latreille, 1825, p. 408, Insecta).

Superfamily Cystoforaminifera (Vesiculata) EIMER & FICKERT, 1899, p. 67 ((*partim*) [*nom. nud.*].

Amphistomata AVERINTSEV, 1906, p. 316 (*partim*).

Superfamily Gromiides POCHE, 1913, p. 173 [*nom. transl. ex* family Gromidea Reuss, 1862].

Superfamily Amphitrematides POCHE, 1913, p. 174.

Family group Monostomata RHUMBLER, 1928, p. 3 (*partim*) [*nom. nud.*].

Test chitinous, without distinct siliceous scales or plates, but commonly with agglutinated foreign material.

Family GROMIIDAE Reuss, 1862

Family Gromiidae EIMER & FICKERT, 1899, p. 670 [*nom. correct. pro* family Gromidea Reuss, 1862].

Family Gromidea REUSS, 1862, p. 362.

Family Gromida CARPENTER, PARKER & JONES, 1862, p. 63 [*nom. correct. pro* family Gromidea Reuss, 1862].

Family Gromidae CLAUS, 1872, p. 108 [*nom. correct. pro* family Gromidea Reuss, 1862].

Family Gromidee SCHWAGER, 1876, p. 484 [*nom. correct. pro* family Gromidea Reuss, 1862].

Family Gromiina BÜTSCHLI *in* Bronn, 1880, p. 186 [*nom. correct. pro* family Gromidea Reuss, 1862].

Family Pamphagidae TARÁNEK, 1882a, p. 232.

Family Pseudodifflugiidae TARÁNEK, 1882a, p. 233.

Family Chlamydophryidae TARÁNEK, 1882a, p. 235.

Family Monostomina LANKESTER, 1885, p. 845 (*partim*) [*nom. nud.*].

Family Adjungentiidae RHUMBLER, 1895a, p. 93, 95 (*partim*) [*nom. nud.*].

Family Nuditestiidae RHUMBLER, 1895a, p. 93, 94 [*nom. nud.*].

Family Grominae DELAGE & HÉROUARD, 1896, p. 116 [*nom. correct. pro* family Gromidea Reuss, 1862].

Subfamily Monostominae CALKINS, 1901, p. 106 (*partim*) [*nom. nud.*].

Subfamily Pseudo-Gromiinae WAILES *in* Cash, Wailes & Hopkinson, 1915, p. 100 [*nom. nud.*].

Subfamily Pseudogromiinae CALKINS, 1926, p. 361 [*nom. correct. pro* subfamily Pseudo-Gromiinae Wailes, 1915, *nom. nud.*].

Subfamily Chlamydophryinae DE SAEDELEER, 1934, p. 6, 32 [*nom. transl. ex* family Chlamydophryidae Taránek, 1882].

Subfamily Pseudodifflugiinae DE SAEDELEER, 1934, p. 6, 44 [*nom. transl. ex* family Pseudodifflugiidae Taránek, 1882].

Subfamily Gromiinae DE SAEDELEER, 1934, p. 6, 47 [*nom. transl. ex* family Gromidea Reuss, 1862].

Test chitinous, rigid or slightly flexible, without distinct plates or scales, but with some siliceous elements, and commonly with foreign material.

Family AMPHITREMIDAE Poche, 1913

Family Amphitremidae GROSPIETSCH, 1958, p. 35 [*nom. correct. pro* family Amphitrematidae Poche, 1913].

Family Amphitrematidae POCHE, 1913, p. 174.

Monothalamia amphistomata HERTWIG & LESSER, 1874, p. 137 (*partim*) [*nom. nud.*].

Family Amphistomina BÜTSCHLI *in* Bronn, 1880, p. 188 (*partim*) [*nom. nud.*].

Family Amphistominae DELAGE & HÉROUARD, 1896, p. 116 (*partim*) [*nom. correct. pro* family Amphistomina Bütschli, 1880, *nom. nud.*].

Family Amphistomidae SCHOUTEDEN, 1906, p. 358 (*partim*) [*nom. correct. pro* family Amphistomina Bütschli, 1880, *nom. nud.*].

Subfamily Amphitreminae GALLOWAY, 1933, p. 45 [*nom. transl. ex* family Amphitrematidae Poche, 1913].

Tribus Amphistomini DE SAEDELEER, 1934, p. 8, 86 (*partim*) [*nom. nud.*].

Test chitinous and may include foreign material; apertures at both poles of the test.

Superfamily EUGLYPHACEA Wallich, 1864, *nom. transl.*

Superfamily Euglyphacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Euglyphidae Wallich, 1864].

Monostomata SCHULZE, 1877, p. 28 (*partim*)

Family group Monostomata RHUMBLER, 1928, p. 3 (*partim*).

Test composed of variously shaped siliceous scales.

Family EUGLYPHIDAE Wallich, 1864

Family Euglyphidae SCHULZE, 1877, p. 28 [*nom. transl. ex* subfamily Euglyphidae Wallich, 1864].

Subfamily Euglyphidae WALLICH, 1864, p. 217, 240.

Family Euglyphina BÜTSCHLI *in* Bronn, 1880, p. 185 [*nom. correct. pro* family Euglyphidae Schulze, 1877].

Family Monostomina LANKESTER, 1885, p. 845 (*partim*) [*nom. nud.*].

Family Protrudentiidae RHUMBLER, 1895a, p. 94, 95 (*partim*) [*nom. nud.*].

Family Euglyphinae DELAGE & HÉROUARD, 1896, p. 112 [*nom. correct. pro* family Euglyphidae Schulze, 1877].

Subfamily Euglyphinae DE SAEDELEER, 1934, p. 6, 27 [*nom. correct. pro* subfamily Euglyphidae Wallich, 1864].

Tribus Euglyphini DE SAEDELEER, 1934, p. 6, 27 [*nom. transl. ex* subfamily Euglyphidae Wallich, 1864].

Family Trinemidae (Euglyphina) HOOGENRAAD & DE GROOT, 1940, p. 24.

Subfamily Trineminae (Monostomina) HOOGENRAAD & DE GROOT, 1940, p. 24.

Family Assulinidae JUNG, 1942a, p. 257.

Family Euglyphida COPELAND, 1956, p. 191 [*nom. van.*].

Test hyaline, symmetrical, elongate, composed of rounded siliceous scales, aperture rounded to elongate; one nucleus.

Family CYPHODERIIDAE de Saedeleer, 1934

Family Cyphoderiidae JUNG, 1942a, p. 257 [*nom. transl. ex* tribe Cyphoderini de Saedeleer, 1934].

Family Revolventiidae RHUMBLER, 1895a, p. 94, 95 [*nom. nud.*].

Tribus Cyphoderini DE SAEDELEER, 1934, p. 6.

Test elongate, generally recurved near the anterior end, composed of very small rounded siliceous scales, aperture simple or with a thin hyaline disk-shaped collar.

Family PAULINELLIDAE de Saedeleer, 1934

Family Paulinellidae DEFLANDRE *in* Grassé, 1953, p. 135 [*nom. transl. ex* subfamily Paulinellinae de Saedeleer, 1934].

Subfamily Paulinellinae DE SAEDELEER, 1934, p. 6, 31.

Test symmetrical, composed of very elongate siliceous rectangular plates with rounded margins, arranged in alternating transverse rows, their imbrication resulting in a hexagonal appearance; aperture elongate; commonly with symbiotic algae.

Subclass GRANULORETICULOSIA de Saedeleer 1934, *nom. correct.* and *nom. transl.*

Subclass Granuloreticulosia LOEBLICH & TAPPAN, herein [*nom. correct.* and *nom. transl. ex* order Granuloreticulosa de Saedeleer, 1934].

Rhizopoda asphycta HAECKEL, 1862, p. 211 (*partim*).

Class Reticularia LANKESTER, 1885, p. 845 (*partim*).

Order Granuloreticulosa DE SAEDELEER, 1934, p. 7, 50.

Glass Granuloreticulosa DEFLANDRE *in* Grassé, 1953, p. 139.

Pseudopodia delicate and reticulate; cytoplasm minutely granular; protoplasmic movement by shearing or sliding, as in the Subclass Filosia.

Order ATHALAMIDA Haeckel, 1862, *nom. correct.*

Order Athalamida LOEBLICH & TAPPAN, herein [*nom. correct. pro* order Athalamia Haeckel, 1862].

Order Athalamia HAECKEL, 1862, p. 211.

Order Homogenea LANKESTER, 1877, p. 442.

Suborder Amoebaea BÜTSCHLI *in* Bronn, 1880, p. 176 (*partim*).

Order Acystosporés DELAGE & HÉROUARD, 1896, p. 66 (*partim*) [*nom. neg.*].

Order Acystosporidia DELAGE & HÉROUARD, 1896, p. 66 (*partim*).

Suborder Athalamia DE SAEDELEER, 1934, p. 7, 50.

No test or shell, pseudopodia may arise from any position on the surface.

Family BIOMYXIDAE Loeblich & Tappan, *fam. nov.*

Family Amoebaea reticulosa BÜTSCHLI *in* Bronn, 1880, p. 178 (*partim*) [*nom. nud.*].

Family Reticulosa CASH, 1904, p. 222 (*partim*) [*non* Reticulosa Carpenter, Parker & Jones, 1862; *nom. nud.*].

Cytoplasm granular, without division into ectoplasm and endoplasm. Type genus: *Biomyxa* Leidy, 1875.

Order MONOTHALAMIDA Haeckel, 1862, *nom. correct.*

Order Monothalamida LOEBLICH & TAPPAN, herein [*nom. correct. pro* order Monothalamia Haeckel, 1862].

Monothalamia HAECKEL, 1862, p. 211 (*partim*).

Rhizopoda reticulosa testacea SCHOUTEDEN, 1906, p. 376.

Suborder Monothalamia FERNÁNDEZ GALIANO, 1921, p. 28 (*partim*).

Suborder Monotalamos FERNÁNDEZ GALIANO, 1921, p. 28 (*partim*) [*nom. neg.*].

Order Thalamia DEFLANDRE *in* Grassé, 1953, p. 139.

Pseudopodia granulo-reticulose, test simple, chitinous or calcareous, and may include foreign matter. Reproductive cycle does not show alternation of generations.

Remarks.—The Monothalamia of Haeckel originally include *Pleurophrys*, which belongs to this order as here revised, *Lagynis*, *Cornuspira* and *Fissurina*, all now included in the order Foraminiferida, and *Gromia*, which is placed in the order Gromiida. The order Thalamia was used for the present order by Deflandre *in* Grassé, 1953, and credited to Haeckel, 1862. Haeckel used the terms Athalamia, Monothalamia, and Polythalamia, but we have been unable to verify any usage of the term Thalamia prior to that of Deflandre, 1953. As the Monothalamia of Haeckel has priority it is here restricted to include the testaceous genera of the subclass Granuloreticulosia, as opposed to the non-testaceous order Athalamida Haeckel. The third order of the subclass (Foraminiferida) is equivalent to the Polythalamia as used by Haeckel.

Superfamily DIPLOPHRYACEA Taránek, 1882, *nom. transl.*

Superfamily Diplophryacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Diplophryidae Taránek, 1882].

Monostomata SCHULZE, 1877, p. 28 (*partim*).

Amphistomata AVERINTSEV, 1906, p. 316 (*partim*).

Order Allogromidiaceae HARTOG *in* Harmer & Shipley, 1906, p. 58.

Superfamily Microcometides POCHE, 1913, p. 175.

Family group Archi-Monothalamidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 85 (*partim*).

Order Archi-Monothalamidia CALKINS, 1926, p. 354.

Family group Monostomata RHUMBLER, 1928, p. 3 (*partim*).

Legio Allogromiidia DE SAEDELEER, 1934, p. 7, 52 [*nom. transl. ex* subfamily Allogromiinae Rhumbler, 1904].

Superfamily Allogromioidea CHAPMAN & PARR, 1936, p. 141 [*nom. transl. ex* subfamily Allogromiinae Rhumbler, 1904].

Order Monosomatia COPELAND, 1956, p. 183 (*partim*).

Superfamily Allogromiidea POKORNÝ, 1958, p. 158 [*nom. correct. pro* superfamily Allogromioidea Chapman & Parr, 1936].

Order Allogromiida FURSENKO, 1958, p. 22. Characters as in the order.

Family DIPLOPHRYIDAE Taránek, 1882

Family Diplophryidae TARÁNEK, 1882a, p. 235.

Monothalamia amphistomata HERTWIG & LESSER, 1874, p. 137 (*partim*) [*nom. nud.*].

Family Amphistomina BÜTSCHLI *in* Bronn, 1880, p. 188 (*partim*) [*nom. nud.*].

Family Nuditestiidae RHUMBLER, 1895a, p. 93, 94 (*partim*) [*nom. nud.*].

Family Amphistominae DELAGE & HÉROUARD, 1896, p. 116 *partim*) [*nom. correct. pro* family Amphistomina Bütschli, 1880; *nom. nud.*].

Polystomata AVERINTSEV, 1906, p. 129, 322 [*nom. nud.*].

Group Polystomata SCHOUTEDEN, 1906, p. 373.

Family Polystomidae SCHOUTEDEN, 1906, p. 358 [*nom. nud.*].

Family Amphistomidae SCHOUTEDEN 1906, p. 358 (*partim*) [*nom. correct. pro* family Amphistomina Bütschli, 1880, *nom. nud.*].

Family Microcometidae POCHE, 1913, p. 175.

Subfamily Amphistominae CALKINS, 1933, p. 470 [*nom. transl. ex* family Amphistomina Bütschli, 1880, *nom. nud.*].

Tribus Amphistomini DE SAEDELEER, 1934, p. 8, 86 (*partim*) [*nom. transl. ex* family Amphistomina Bütschli, 1880, *nom. nud.*].

Subfamily Polystominae DE SAEDELEER, 1934, p. 8 [*nom. transl. ex* family Polystomidae Schouteden, 1906, *nom. nud.*].

Tribus Polystomini DE SAEDELEER, 1934, p. 8, 83 [*nom. transl. ex* family Polystomidae Schouteden, 1906, *nom. nud.*].

Family Microcometesidae GROSPIETSCH, 1958, p. 35, 57 [*nom. correct. pro* family Microcometidae Poche, 1913].

Test small, membranous and may have ferruginous encrustations, apertures numerous.

Family ALLOGROMIIDAE Rhumbler, 1904

Family Allogromiidae SCHOUTEDEN, 1906, p. 374 [*nom. correct. pro* family Allogromida Averintsev, 1906].

Family Monostomina LANKESTER, 1885, p. 845 (*partim*) [*nom. nud.*].

Family Nuditestiidae RHUMBLER, 1895a, p. 93, 94 (*partim*) [*nom. nud.*].

Subfamily Monstominae CALKINS, 1901, p. 106 (*partim*) [*nom. nud.*].

Subfamily Allogromiinae RHUMBLER, 1904, p. 202.

Subfamily Craterininae RHUMBLER, 1904, p. 196 [=Allogromiinae].

Family Allogromida AVERINTSEV, 1906, p. 324 [*nom. transl. ex* sub-family Allogromiinae Rhumbler, 1904].

Subfamily Arrogromnia RHUMBLER, 1913, p. 343 [*nom. van.*].

Subfamily Rhynchogromiinae GALLOWAY, 1933, p. 52.

Subfamily Lieberkuehniinae DE SAEDELEER, 1934, p. 7, 64.

Tribus Lieberkuehniini DE SAEDELEER, 1934, p. 7, 64.

Tribus Pleurophryini DE SAEDELEER, 1934, p. 7, 60.

Tribus Allelogromiini DE SAEDELEER, 1934, p. 7, 67.

Family Allogromidae DOGEL, 1951, p. 464 [*nom. van. pro* family Allogromiidae Schouteden, 1906].

Family Allogromiida COPELAND, 1956, p. 183 [*nom. van.*]

Test free, a single chamber of medium to large size, generally chitinous, chitino-calcareous or with some agglutinated foreign material, may have inverted neck or partial septum, aperture single.

Remarks.—The genera included here may be of polyphyletic origin, and many are not well known. Wall composition and structure differ considerably in different genera, but all are simple in form, and they are here united because of their similarity in pseudopodial character, and the absence of an alternation of generations. Recent studies by Arnold (1955) indicate an alternation of generations in *Allogromia* with the production of amoeboid gametes, although actual fusion of the amoeboid bodies was not observed. If substantiated, this would necessitate removal of *Allogromia* to the order Foraminiferida, although only the superfamily Spirillinacea of that order has been reported to have amoeboid gametes. Pending further investigation, *Allogromia* is here retained in the Monothalamida.

Family MIKROGROMIIDAE de Saedeleer, 1934

Family Mikrogromiidae DE SAEDELEER, 1934, p. 7, 68.

Family Monostomina LANKESTER, 1885, p. 845 (*partim*) [*nom. nud.*].

Subfamily Monostominae CALKINS, 1901, p. 106 (*partim*) [*nom. nud.*].

Tribus Mikrogromiini DE SAEDELEER, 1934, p. 7, 68.

Tribus Belariini DE SAEDELEER, 1934, p. 7, 79.

Tribus Heterogromiini DE SAEDELEER, 1934, p. 7, 82.

Family Microgromiidae DOFLEIN & REICHENOW, 1952, p. 730 [*nom. van. pro* family Mikrogromiidae de Saedeleer, 1934].

Test membranous, may have ferruginous encrustations; of small size, commonly attached and may form colonies. Single aperture.

Order FORAMINIFERIDA Zborzewski, 1834

Order Foraminiferida T. L. JAHN & F. F. JAHN, 1949, p. 128 [*nom. correct. pro* order Foraminifera Claparède & Lachmann, 1859].

Class Polythalamiis BREYN, 1732 (*fide* Sherborn, 1888, p. 18).

Ordre Polypes à rayons LAMARCK, 1801, p. 360 (*partim*) [*nom. neg.*].

Section Polypes coralligenes LAMARCK, 1801, p. 365 (*partim*) [*nom. neg.*].

Asiphoidea DE HAAN, 1825, p. 20.

Order Foraminifères D'ORBIGNY, 1826, p. 131 [*nom. neg.*].

Foraminifera ZBORZEWSKI, 1834, p. 311.

Class Foraminifères D'ORBIGNY in de la Sagra, 1839, p. xxxi [*nom. neg.*].

Ordo Polythalamia EHRENBERG, 1839, table opposite p. 120.
Monosomatia EHRENBERG, 1839, table opposite p. 120.
Polysomatia EHRENBERG, 1839, table opposite p. 120.
Testacea SCHULTZE, 1854, p. 52 (*partim*).
Order Foraminifera CLAPARÈDE & LACHMANN, 1859, p. 432, 434.
Family Foraminifera PRITCHARD, 1861, p. 201 [*nom. nud.*].
Order Reticularia CARPENTER, PARKER & JONES, 1862, p. 28.
Order Reticulosa CARPENTER, PARKER & JONES, 1862, p. 17.
Thalamophora HERTWIG, 1876, p. 53 (*partim*).
Division Polythalamia MARRIOTT, 1878, p. 30.
Suborder Amoebaea BÜTSCHLI *in* Bronn, 1880, p. 176 (*partim*).
Order Thalamophoren HERTWIG, 1893, p. 156 [*nom. neg.*].
Polythalamien HERTWIG, 1893, p. 158 [*nom. neg.*].
Subclass Foraminiferiae DELAGE & HÉROUARD, 1896, p. 107.
Order Reticulariida CALKINS, 1901, p. 106 (*partim*).
Reticulariidae CALKINS, 1909, p. 25.
Subclass Foraminifera CALKINS, 1909, p. 38.
Suborder Polythalamia DOFLEIN, 1911, p. 633.
Suborder Arforaminiferia RHUMBLER, 1913, p. 341.
Order Foraminíferos FERNÁNDEZ GALIANO, 1921, p. 26 [*nom. neg.*].
Suborder Politálamos FERNÁNDEZ GALIANO, 1921, p. 29 [*nom. neg.*].
Order Foraminiferae CHATTON, 1925, p. 76.

Protoplasmic body protected by a generally multichambered test, which may be imperforate or finely perforate, basically chitinous, but variously modified to have wall of aggutinated particles, or of secreted material, rarely of silica or aragonite, more commonly of calcite (either porcellaneous, hyaline microgranular or hyaline radiate in structure, of a single layer, two or more layers, or with or without a canal system of varying complexity). Test commonly pierced by one or more apertures, and may have fine perforations in addition, through all of which are extruded the granuloreticulose pseudopodia. Marine to brackish water environment, free-living, benthonic or pelagic, or attached to a substratum, very rarely parasitic. Reproduction characterized by an alternation of generations, asexual and sexual, although the latter may be relatively suppressed. Biflagellate gametes, except for superfamily Spirillinacea which has amoeboid gametes.

Superfamily LAGYNACEA Schultze, 1854, *nom. correct.*

Superfamily Lagynacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Lagynidea Sigal, 1952.].
Monothalamia SCHULTZE, 1854, p. 52 (*partim*).
Monostomata SCHULZE, 1877, p. 28 (*partim*).
Division Monothalamia MARRIOTT, 1878, p. 30 (*partim*).
Monothalamien HERTWIG, 1893, p. 157 [*nom. neg.*].
Order Monthalamia HAECKEL, 1894, p. 164 (*partim*).
Order Acystosporés DELAGE & HÉROUARD, 1896, p. 66 (*partim*) [*nom. neg.*].
Order Acystosporidia DELAGE & HÉROUARD, 1896, p. 66 (*partim*).
Suborder Monothalamia FERNÁNDEZ GALIANO, 1921, p. 28 (*partim*).
Suborder Monotálamos FERNÁNDEZ GALIANO, 1921, p. 28 (*partim*) [*nom. neg.*].
Family group Archi-Monothalamidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 85 (*partim*).
Family Group Monostomata RHUMBLER, 1928, p. 3 (*partim*).
Suborder Uniloculinidea SIGAL *in* Piveteau, 1952, p. 154 (*partim*).
Superfamily Lagynidea SIGAL *in* Piveteau, 1952, p. 154 [*nom. transl. ex* family Lagynida Schultze, 1854].

Free or attached, may occur in empty shells of other species and may be parasitic, test unilocular, with chitinous or gelatinous imperforate wall, rarely with agglutinated particles, aperture generally single.

Family LAGYNIDAE Schultze, 1854

Family Lagynidae GALLOWAY, 1933, p. 39 [*nom. correct. pro* family Lagynida Schultze, 1854].
Family Lagynida SCHULTZE, 1854, p. 52.

Family Amoebaea reticulosa BÜTSCHLI *in* Bronn, 1880, p. 178 (*partim*) [*nom. nud.*].
Subfamily Myxothecinae RHUMBLER, 1895b p. 79.
Subfamily Monostominae CALKINS, 1901, p. 106 (*partim*) [*nom. nud.*].
Subfamily Armyxothecnia RHUMBLER, 1913, p. 343 [*nom. van.*].
Subfamily Lagyninae GALLOWAY, 1933, p. 41 [*nom. transl. ex* family Lagynida Schultze, 1854].
Characters as in the superfamily.

Superfamily AMMODISCACEA Reuss, 1862, *nom. correct.*

Superfamily Ammodiscacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Ammodiscoidea Chapman, Parr & Collins, 1934].
Foraminifera Monomera REUSS, 1862, p. 362 (*partim*) [*non* Monomera Latreille, 1825, p. 408, Insecta].
Order Physemaria HAECKEL, 1877, p. 221 (*partim*).
Class Gastraeada HAECKEL, 1877, p. 221 (*partim*).
Order Astrorhizidea LANKESTER, 1885, p. 846.
Subclass Imperforata LANKESTER, 1885, p. 845 (*partim*).
Tribe Astrorhizina DELAGE & HÉROUARD, 1896, p. 128 [*nom. transl. ex* family Astrorhizidae Brady, 1881].
Suborder Arenacidae DELAGE & HÉROUARD, 1896, p. 127.
Superfamily Siphonoforaminifera (Tubulata) EIMER & FICKERT, 1899, p. 667 [*nom. nud.*].
Superfamily Stichostegia EIMER & FICKERT, 1899, p. 674 (*non* Stichostègues d'Orbigny, 1826) (*partim*) [*nom. nud.*].
Psammatostichostegia EIMER & FICKERT, 1899, p. 674 [*nom. nud.*].
Superfamily Ascoforaminifera EIMER & FICKERT, 1899, p. 673 [*nom. nud.*].
Superfamily Cystoforaminifera (Vesiculata) EIMER & FICKERT, 1899, p. 670 (*partim*) [*nom. nud.*].
Superfamily Astrorhizidae EIMER & FICKERT, 1899, p. 593 [*nom. transl. ex* family Astrorhizidae Brady, 1881].
Suborder Imperforina CALKINS, 1901, p. 106 (*partim*).
Order Astrorhizidaceae HARTOG *in* Harmer & Shipley, 1906, p. 59.
Order Astrorhizida CALKINS, 1909, p. 38.
Protammida SCHUBERT, 1920, p. 145.
Metammida SCHUBERT, 1920, p. 146.
Family Group Archi-Monothalamidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 85 (*partim*).
Order Archimonothalamia KÜHN, 1926, p. 127.
Suborder Monothalamia DE SAEDELEER, 1934, p. 7, 52 (*non* Monothalamia Schultze, 1854).
Superfamily Ammodiscoidea CHAPMAN, PARR & COLLINS, 1934, p. 556 [*nom. transl. ex* family Ammodiscinea Reuss, 1862].
Superfamily Astrorhizidea GLAESSNER, 1945. p. 88 [*nom. correct. pro* superfamily Astrorhizidae Eimer & Fickert, 1899].
Suborder Monothalamia AVNIMELECH, 1952, p. 63 (*non* Monothalamia Schultze, 1854; Marriott, 1878; Haeckel, 1894; nor de Saedeleer, 1934).
Suborder Uniloculinidea SIGAL *in* Piveteau, 1952, p. 154 (*partim*).
Suborder Biloculinidea SIGAL *in* Piveteau, 1952, p. 157 (*partim*).
Legion Archithalamia DOFLEIN & REICHENOW, 1952, p. 730.
Suborder Astrorhizidea JÍROVEC, 1953, p. 334.
Order Monosomatia COPELAND, 1956, p. 183 (*partim*).
Order Ammodiscida FURSENKO, 1958, p. 23.
Superfamily Ammodiscidea DAIN *in* Rauser-Chernousova & Fursenko, 1959, p. 180 [*nom. correct. pro* superfamily Ammodiscoidea Chapman, Parr & Collins, 1934].
Superfamily Astrorhizicae EASTON, 1960, p. 65 [*nom. correct. pro* superfamily Astrorhizidae Eimer & Fickert, 1899].

Test irregular, spheroidal or tubular and straight, branching or enrolled; non-septate or only irregularly constricted; well agglutinated, simple or labyrinthic; aperture simple.

Family ASTRORHIZIDAE Brady, 1881

Family Astrorhizidae BRADY, 1881, p. 41, 43.
Family Arenacea BÜTSCHLI *in* Bronn, 1880, p. 193 [*nom. nud.*].
Family Rhabdamminina LANKESTER, 1885,

p. 846 [*nom. transl. ex* subfamily Rhabdamminae Brady, 1884].

Family Astrorhizina LANKESTER, 1885, p. 846 [*nom. correct. pro* family Astrorhizidae Brady, 1881].

Family Ammodinetta HAECKEL, 1894, p. 164 [*nom. nud.*].

Family Rhabdamminidae RHUMBLER, 1895b, p. 79 [*nom. correct. pro* family Rhabdamminina Lankester, 1885].

Family Astrorhizinae DELAGE & HÉROUARD, 1896, p. 129 [*nom. correct. pro* family Astrorhizidae Brady, 1881].

Family Rhabdamminae DELAGE & HÉROUARD, 1896, p. 130 [*nom. correct. pro* family Rhabdamminina Lankester, 1885].

Family Dendrophryidae EIMER & FICKERT, 1899, p. 669.

Family Saccorhizidae EIMER & FICKERT, 1899, p. 670.

Family Ammoasconidae EIMER & FICKERT, 1899, p. 673 [*nom. nud.*].

Family Serpuleidae EIMER & FICKERT, 1899, p. 674 [*nom. nud.*].

Family Hyperamminidae EIMER & FICKERT, 1899, p. 674.

Family Arrhabdammidia RHUMBLER, 1913, p. 342 [*nom. van. pro* family Rhabdamminidae Rhumbler, 1895].

Family Rhizamminidae WIESNER, 1931, p. 79 [*nom. transl. ex* subfamily Rhizamminae Rhumbler, 1895].

Family Astrorhizida COPELAND, 1956, p. 183 [*nom. van.*].

Test free or attached, non-septate, tubular or branching, not enrolled; wall simple, with chitinous inner layer, agglutinated outer layer; aperture absent or terminal, rounded.

Subfamily ASTRORHIZINAE Brady, 1881

Subfamily Astrorhizinae BRADY, 1884, p. 61 [*nom. transl. ex* family Astrorhizidae Brady, 1881].

Subfamily Rhabdammininae BRADY, 1884, p. 64.

Subfamily Arastrorhiznia RHUMBLER, 1913, p. 344 [*nom. van. pro* subfamily Astrorhizinae Brady, 1881].

Subfamily Arrhabdamnia RHUMBLER, 1913, p. 350 [*nom. van. pro* subfamily Rhabdamminae Brady, 1884].

Test free, with simple or branching tubes extending from a central chamber; aperture at the open ends of the tubes.

Subfamily RHIZAMMININAE Rhumber, 1895

Subfamily Rhizamminae RHUMBLER. 1895b, p. 82.

Subfamily Arrhizamnia RHUMBLER, 1913, p. 350 [*nom. van. pro* subfamily Rhizamminae Rhumbler, 1895].

Subfamily Psammosiphonellinae AVNIMELECH, 1952, p. 64.

Subfamily Argillotubinae AVNIMELECH, 1952, p. 64.

Subfamily Micatubinae AVNIMELECH, 1952, p. 65.

Subfamily Bathysiphoninae AVNIMELECH, 1952, p. 66.

Subfamily Testulosiphoninae AVNIMELECH, 1952, p. 66.

Test tubular, both ends open.

Subfamily HIPPOCREPININAE Rhumbler, 1895

Subfamily Hippocrepininae RHUMBLER, 1895b, p. 83.

Subfamily Hyperammininae CUSHMAN, 1910, p. 59 [*nom. transl. ex* family Hyperamminidae Eimer & Fickert, 1899].

Subfamily Arhippocrepnia RHUMBLER, 1913, p. 352 [*nom. van. pro* subfamily Hippocrepininae Rhumbler, 1895].

Test free, globular proloculus continuing into non-septate tube; aperture at open end of tube.

Subfamily DENDROPHRYINAE Eimer & Fickert, 1899

Subfamily Dendrophryinae CUSHMAN, 1927, p. 14 [*nom. transl. ex* family Dendrophryidae Eimer & Fickert, 1899].

Test attached, commonly branching or occurring in clusters.

Family SACCAMMINIDAE Brady, 1884

Family Saccamminidae EIMER & FICKERT, 1899, p. 671 [*nom. correct. pro* family Saccamminina Lankester, 1885].

Family Arenacea BÜTSCHLI *in* Bronn, 1880, p. 193 (*partim*) [*nom. nud.*].

Family Saccamminina LANKESTER, 1885, p. 846 [*nom. transl. ex* subfamily Saccammininae Brady, 1884].

Family Pilulinina LANKESTER, 1885, p. 846 [*nom. transl. ex* subfamily Pilulininae Brady, 1884].

Family Saccamminae DELAGE & HÉROUARD, 1896, p. 130 [*nom. correct. pro* family Saccamminina Lankester, 1885].

Family Protocystidae EIMER & FICKERT, 1899, p. 665 [*nom. nud.*].
Family Psammosphaeridae EIMER & FICKERT, 1899, p. 670.
Family Kyphamminidae EIMER & FICKERT, 1899, p. 672 [*nom. nud.*].
Family Ammoasconidae EIMER & FICKERT, 1899, p. 673 (*partim*) [*nom. nud.*].
Family Pilulinidae LISTER *in* Lankester, 1903, p. 141 [*nom. correct. pro* family Pilulinina Lankester, 1885].
Family Stegnamminidae MOREMAN, 1930, p. 48.
Family Alexandrellidae BYKOVA, 1958, p. 881 [*nom. nud.*].

Test free or attached, subglobular, or in groups; aperture absent or single or multiple.

Subfamily PSAMMOSPHAERINAE Eimer & Fickert, 1899

Subfamily Psammosphaerinae CUSHMAN, 1927, p. 11 [*nom. transl. ex* family Psammosphaeridae Eimer & Fickert, 1899].
Subfamily Stegnammininae MOREMAN, 1930, p. 48.
Subfamily Thekammininae DUNN, 1942, p. 326.

Test free, globular or with several loosely joined chambers, no aperture.

Subfamily SACCAMMININAE Brady, 1884

Subfamily Saccammininae BRADY, 1884, p. 64.
Subfamily Pilulininae BRADY, 1884, p. 63.
Subfamily Arsaccamnia RHUMBLER, 1913, p. 347 [*nom. van.*].
Subfamily Pelosininae CUSHMAN, 1927, p. 12.

Test free, definite aperture.

Subfamily HEMISPHAERAMMININAE Loeblich & Tappan, *subfam. nov.*

Test attached, consisting of one or more subglobular or hemispherical chambers. Type genus, *Hemisphaerammina* Loeblich & Tappan, 1957.

Family AMMODISCIDAE Reuss, 1862

Family Ammodiscidae RHUMBLER, 1895b, p. 83 [*nom. correct. pro* family Ammodiscinea Reuss, 1862].
Family Ammodiscinea REUSS, 1862, p. 365.
Family Ammodisculinidae RHUMBLER, 1913, p. 339 [*nom. van.*].
Family Arammodisclidia RHUMBLER, 1913, p. 341 [*nom. van.*].
Family Tolypamminidae LOEBLICH & TAPPAN, 1954, p. 308 [*nom. transl. ex* subfamily Tolypammininae Cushman, 1928].
Family Ammodiscida COPELAND, 1956, p. 185 [*nom. van.*].

Test free or attached, proloculus followed by non-septate enrolled tubular second chamber, aperture formed by the open end of the tube.

Subfamily AMMODISCINAE Reuss, 1862

Subfamily Ammodiscinae RHUMBLER, 1904, p. 275 [*nom. transl. ex* family Ammodiscinea Reuss, 1862].
Subfamily Arammodiscinia RHUMBLER, 1913, p. 385 [*nom. van.*].

Test free, planispiral, or irregularly coiled.

Subfamily TOLYPAMMININAE Cushman, 1928

Subfamily Tolypammininae CUSHMAN, 1928a, p. 103.

Test attached, proloculus followed by tubular second chamber, coiled or irregular.

Family BOTELLINIDAE Chapman & Parr, 1936, *nom. transl.*

Family Botellinidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Botellininae Chapman & Parr, 1936].
Family Ammoasconidae EIMER & FICKERT, 1899, p. 673 (*partim*) [*nom. nud.*].
Subfamily Botellininae CHAPMAN & PARR, 1936, p. 146.

Single chambered, with agglutinated wall and labyrinthic interior.

Superfamily LITUOLACEA Lamarck, 1809, *nom. correct.*

Superfamily Lituolacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Lituolidea Glaessner, 1945].
Tribu Orthocerata LATREILLE, 1825, p. 162 (*partim*).
Suborder Monosomatia EHRENBERG, 1839, table opposite p. 120 (*partim*).
Order Helicostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 27 (*partim*) [*nom. neg.*].
Order Énallostègues D'ORBIGNY in de la Sagra, 1839, p. xxxix, 125 (*partim*) [*nom. neg.*].

Order Cyclostègues D'ORBIGNY, 1851, p. 192 (*partim*) [*nom. neg.*].
Group Helicoidea SCHULTZE, 1854, p. 53.
Enallostegia REUSS, 1860, p. 151, 231 (*partim*).
Helicostegia REUSS, 1860, p. 151, 205 (*partim*).
Turbinoidea REUSS, 1860, p. 151 (*partim*).
Foraminifera Polymera REUSS, 1862, p. 365 (*partim*).
Group Imperforata CLAUS, 1872, p. 108 (*partim*).
Subclass Perforata LANKESTER, 1885, p. 847 (*partim*).
Subclass Imperforata LANKESTER, 1885, p. 845 (*partim*).
Order Textularidea LANKESTER, 1885, p. 847.
Order Lituolidea LANKESTER, 1885, p. 847.
Order Polystegia HAECKEL, 1894, p. 164 (*partim*).
Suborder Textularidae DELAGE & HÉROUARD, 1896, p. 139.
Tribu Lituolina DELAGE & HÉROUARD, 1896, p. 132 [*nom. transl. ex* family Lituolacea Lamarck, 1809].
Superfamily Enclinostegia EIMER & FICKERT, 1899, p. 682 (*partim*) [*nom. nud.*].
Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 685 (*partim*) [*nom. nud.*].
Suborder Imperforina CALKINS, 1901, p. 106 (*partim*).
Suborder Perforina CALKINS, 1901, p. 108 (*partim*).
Order Textularidea LISTER *in* Lankester, 1903, p. 143.
Order Lituolidea LISTER *in* Lankester, 1903, p. 142.
Order Lituolidaceae HARTOG *in* Harmer & Shipley, 1906, p. 59.
Order Textulariaceae HARTOG *in* Harmer & Shipley, 1906, p. 59.
Order Lituolida CALKINS, 1909, p. 39.
Order Textularida CALKINS, 1909, p. 39.
Schizostoma SCHUBERT, 1920, p. 179 (*partim*).
Family Group Textulinidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88 (*partim*).
Family Group Nodosalidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 86 (*partim*).
Family Group Rotaliaridia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88 (*partim*).
Order Textulinida CALKINS, 1926, p. 356 (*partim*).
Order Nodosalidia CALKINS, 1926, p. 355 (*partim*).
Order Textularidia KÜHN, 1926, p. 150.
Order Rotaliaridia KÜHN, 1926, p. 152 (*partim*).
Order Orthostili (Perforata) SILVESTRI, 1937, p. 89 (*partim*).
Order Hellenoidea WEDEKIND, 1937, p. 79 (*partim*).
Suborder Textulariacea WEDEKIND, 1937, p. 84.
Suborder Haplophragmiacea WEDEKIND, 1937, p. 111.
Superfamily Lituolidea GLAESSNER, 1945, p. 93 [*nom. transl. ex* family Lituolacea Lamarck, 1809].
Order Dentata HOFKER, 1951, p. 14 (*partim*).
Suborder Protoforaminata HOFKER, 1951, p. 42 (*partim*).
Suborder Pluriloculinidea SIGAL *in* Piveteau, 1952, p. 160 (*partim*).
Suborder Textulariidea JÍROVEC, 1953, p. 335.
Order Textulariida FURSENKO, 1958, p. 23.
Order Ataxophragmiida FURSENKO, 1958, p. 23.
Superfamily Lituolicae BRONNIMANN, 1958, p. 176 [*nom. correct. pro* superfamily Lituolidea Glaessner, 1945].

Multilocular, typically spirally coiled, or uncoiled or straight, reduction of chambers per whorl may result in triserial or biserial arrangement; chambers simple or labyrinthic; wall siliceous or agglutinated, with calcareous, siliceous or ferruginous cement; aperture single or multiple.

Family RZEHAKINIDAE Cushman, 1933

Family Rzehakinidae TAPPAN, 1957, p. 210 [*nom. transl. ex* subfamily Rzehakininae Cushman, 1933].
Subfamily Rzehakininae CUSHMAN, 1933, p. 144.
Subfamily Silicininae EARLAND, 1933, p. 89 (*non* subfamily Silicininae Cushman, 1933; *non* family Silicinidae Cushman, 1927) [*nom. nud.*, not based on genus *Silicina* Bornemann, 1874].
Family Paramiliolidae SIGAL *in* Piveteau, 1952, p. 208 [*nom. nud.*].

Test free, proloculus followed by tubular chambers, about one half coil in length and added in various planes, as in the calcareous imperforate Miliolidae; wall siliceous or agglutinated, generally insoluble in acid.

Family ASCHEMONELLIDAE Eimer & Fickert, 1899

Family Aschemonellidae EIMER & FICKERT, 1899, p. 676.

Family Arenacea BÜTSCHLI *in* Bronn, 1880, p. 193 [*nom. nud.*].

Family Nodosamminidae RHUMBLER, 1913, p. 339 (*partim*) [*nom. nud.*].

Family Arnodosammidia RHUMBLER, 1913, p. 341 (*partim*) [*nom. van.*].

Family Reophacidae CUSHMAN, 1927, p. 15 [*nom. transl. ex* subfamily Reophacinae Cushman, 1910].

Family Silicinidae CUSHMAN, 1927, p. 29.

Family Reophacida COPELAND, 1956, p. 186 [*nom. van.*].

Test free, chambers arranged in straight or curved series; wall agglutinated, aperture terminal.

Remarks.—The family Silicinidae Cushman (1927, p. 29) included genera herein placed in both the Ammodiscidae and Rzehakinidae. However, the original specimens of *Involutina polymorpha* Terquem, the type species of *Silicina* Bornemann, 1874, consist of fragments probably belonging to *Reophax* (Tappan, 1957, p. 210), hence the nominal family is a synonym of the Aschemonellidae.

Subfamily ASCHEMONELLINAE Eimer & Fickert, 1899

Subfamily Aschemonellinae CUSHMAN, 1910, p. 80 [*nom. transl. ex* family Aschemonellidae Eimer & Fickert, 1899].

Subfamily Araschemonellinia RHUMBLER, 1913, p. 439 [*nom. van. pro* subfamily Aschemonellinae Cushman, 1910].

Irregular chambers in rectilinear arrangement.

Subfamily REOPHACINAE Cushman, 1910

Subfamily Reophacinae CUSHMAN, 1910, p. 81.

Subfamily Arreophaxnia RHUMBLER, 1913, p. 440 [*nom. van. pro* subfamily Reophacinae Cushman, 1910].

Subfamily Proteonininae GALLOWAY, 1933, p. 65.

Subfamily Silicininae CUSHMAN, 1933, p. 143 [*nom. transl. ex* family Silicinidae Cushman, 1927].

Subfamily Reophacidinae SILVESTRI, 1950, p. 44 [*nom. van. pro* subfamily Reophacinae Cushman, 1910].

Chambers typically in a regular rectilinear series; wall agglutinated, interior simple; aperture single or multiple.

Subfamily SPHAERAMMININAE Cushman, 1933

Subfamily Sphaeramminae CUSHMAN, 1933, p. 87.

Later chambers completely overlapping and enclosing earlier ones.

Family NOURIIDAE Chapman & Parr, 1936, *nom. transl.*

Family Nouriidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Nouriinae Chapman & Parr, 1936].

Subfamily Nouriinae CHAPMAN & PARR, 1936, p. 149.

Chambers in a loose spiral or biserial, strongly overhanging laterally; aperture terminal.

Family LITUOLIDAE Lamarck, 1809

Family Lituolidae SCHULZE, 1877, p. 28 [*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Lituolacea LAMARCK, 1809, *fide* Agassiz, 1844, p. 15.

Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].

Family Nautiloidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 38 (*partim*) [*nom. nud.*].

Family Lituolitidae BRODERIP, 1839, *fide* Agassiz, 1844, p. 15 [*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Nautiloida SCHULTZE, 1854, p. 53 (*partim*) [*nom. correct. pro* family Nautiloidae d'Orbigny, 1839; *nom. nud.*].

Family Lituolidea REUSS, 1862, p. 308 [*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Lituolida CARPENTER, PARKER & JONES, 1862, p. 140 [*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Lituolidee SCHWAGER, 1876, p. 482

[*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Lituolideae GÜMBEL, 1868, p. 22 [*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Lituolina LANKESTER, 1885, p. 847 [*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Loftusina LANKESTER, 1885, p. 847 [*nom. transl. ex* subfamily Loftusinae Brady, 1884].

Family Spirocyclinidae MUNIER-CHALMAS, 1887, p. xxxi.

Family Lituoletta HAECKEL, 1894, p. 164 [*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Lituolinae DELAGE & HÉROUARD, 1896, p. 132 [*nom. correct. pro* family Lituolacea Lamarck, 1809].

Family Haplophragmidae EIMER & FICKERT, 1899, p. 693.

Family Loftusiidae LISTER *in* Lankester, 1903, p. 142 [*nom. transl. ex* subfamily Loftusinae Brady, 1884].

Family Placopsilinidae CUSHMAN, 1927, p. 41 [*nom. transl. ex* subfamily Placopsilininae Rhumbler, 1913].

Family Haplophragmiidae SIGAL *in* Piveteau, 1952, p. 162 [*nom. correct. pro* family Haplophragmidae Eimer & Fickert, 1899].

Family Barkerinidae SMOUT, 1956, p. 342.

Family Mesoendothryidae VOLOSHINOVA, 1958, p. 19.

Test free or attached, early stage coiled, later may be uncoiled, irregular or annular; wall agglutinated, with calcareous cement or microgranular calcite, interior simple to labyrinthic, epidermal layer imperforate; aperture single or multiple.

Subfamily HAPLOPHRAGMOIDINAE Maync, 1952

Subfamily Haplophragmoidinae MAYNC, 1952, p. 43.

Test free, coiled, interior simple, not labyrinthic, no alveolar hypodermis.

Subfamily BARKERININAE Smout, 1956, *nom. transl.*

Subfamily Barkerininae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Barkerinidae Smout, 1956].

Test planispiral, involute; chambers subdivided by transverse partitions; wall of agglutinated calcareous particles; aperture multiple.

Subfamily CYCLAMMININAE Marie, 1941

Subfamily Cyclammininae MARIE, 1941, p. 257.

Subfamily Choffatellinae MAYNC, 1958, p. 1.

Planispiral to uncoiling; wall with reticulate near surface meshwork beneath imperforate epidermal coating and commonly with labyrinthic interior; aperture single or multiple.

Remarks.—The genus *Mesoendothyra* Dain, 1959, on which was based the family Mesoendothyridae Voloshinova, 1959, is here included.

Subfamily SPIROCYCLININAE Munier-Chalmas, 1887

Subfamily Spirocyclininae MAYNC, 1950, p. 538 [*nom. transl. ex* family Spirocyclinidae Munier-Chalmas, 1887].

Septa simple, chambers subdivided by secondary radial septula into chamberlets, interior labyrinthic, walls and septa divided by ramifying anastomosing channels, alveolar-reticulate hypodermis beneath epidermal coating.

Subfamily LOFTUSIINAE Brady, 1884, *nom. correct.*

Subfamily Loftusiinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Loftusinae Brady, 1884].

Subfamily Loftusinae BRADY, 1884, p. 67.

Test fusiform, elongate along axis of coiling; wall agglutinated, interior labyrinthic; aperture multiple, along base of apertural face.

Subfamily LITUOLINAE Lamarck, 1809

Subfamily Lituolinae BRADY, 1884, p. 65 [*nom. transl. ex* family Lituolacea Lamarck, 1809].

Subfamily Haplophragmiinae CUSHMAN, 1927, p. 19 [*nom. transl. ex* family Haplophragmidae Eimer & Fickert, 1899].

Similar to the Haplophragmoidinae, but spire uncoiling in the adult, interior simple.

Subfamily PLACOPSILININAE Rhumbler, 1913

Subfamily Placopsilininae RHUMBLER, 1913, p. 444.

Subfamily Arplacopsinia RHUMBLER, 1913, p. 444 [*nom. van. pro* subfamily Placopsilininae Rhumbler, 1913].

Test attached, early chambers may be enrolled, later uncoiling; wall simple.

Subfamily COSCINOPHRAGMINAE Thalmann, 1951

Subfamily Coscinophragminae THALMANN, 1951, p. 221 [*nom. subst. pro* subfamily Polyphragminae Rhumbler, 1913].

Subfamily Polyphragminae RHUMBLER, 1913, p. 446 [*nom. nud.*, based on *Polyphragma* Reuss, 1871; not *Polyphragma* Quatrefages, 1865].

Subfamily Arpolyphragminia RHUMBLER, 1913, p. 446 [*nom. van. pro* subfamily Polyphragminae Rhumbler, 1913].

Test attached, wall labyrinthic.

Family ORBITOLINIDAE Martin, 1890

Family Orbitolinidae MARTIN, 1890, p. 226.

Subfamily Orbitolininae CUSHMAN *in* Eastman, 1913, p. 27 [*nom. transl. ex* family Orbitolinidae Martin, 1890].

Family Arorbitolidia RHUMBLER, 1913, p. 342 [*nom. van. pro* family Orbitolinidae Martin, 1890].

Family Orbitolinida COPELAND, 1956, p. 186 [*nom. van.*].

Test conical, compressed or flabelliform, chambers spiralling, later annular, with interseptal partitions; wall calcareous, imperforate, with or without included foreign matter.

Family TEXTULARIIDAE Ehrenberg, 1839

Family Textulariidae CHAPMAN, 1900a, p. 9 [*nom. correct. pro* family Textularina Ehrenberg, 1839].

Family Textularina EHRENBERG, 1839, p. 120.

Family Énallostègues D'ORBIGNY, 1826, p. 260 (*partim*) [*nom. nud.*].

Family Textularidae D'ORBIGNY *in* de la Sagra, 1839, p. 140 [*nom. correct. pro* family Textularina Ehrenberg, 1839].

Family Textilarina AGASSIZ, 1844, p. 4.

Family Turbinoida SCHULTZE, 1854, p. 52 (*partim*) [*nom. nud.*].

Family Textilaridae REUSS, 1860, p. 231 [*nom. correct. pro* family Textilarina Agassiz, 1844].

Family Uvellidea REUSS, 1862, p. 318, 382 (*partim*) [*nom. correct. pro* family Uvellina Ehrenberg, 1839, *nom. nud.*].

Family Textilaridea REUSS, 1862, p. 320 [*nom. correct. pro* family Textilarina Agassiz, 1844].

Family Uvellideae GÜMBEL, 1868, p. 23 (*partim*) [*nom. correct. pro* family Uvellina Ehrenberg, 1839, *nom. nud.*].

Family Textilarida JONES *in* Griffith & Henfrey, 1875, p. 320 [*nom. correct. pro* family Textilarina Agassiz, 1844].

Family Plecanioidea SCHWAGER, 1877, p. 22.

Family Turbinida MARRIOTT, 1878, p. 30 (*partim*) [*nom. correct, pro* family Turbinoida Schultze, 1854, *nom. nud.*].

Family Textilariidae JONES, 1895, p. 140 [*nom. correct. pro* family Textilarina Agassiz, 1844].

Family Textularinae DELAGE & HÉROUARD, 1896, p. 140 [*nom. correct. pro* family Textularina Ehrenberg, 1839].

Family Opistho-Dischistidae EIMER & FICKERT, 1899, p. 677 (*partim*) [*nom. nud.*].

Family Dischistidae EIMER & FICKERT, 1899, p. 678 (*partim*) [*nom. nud.*].

Family Textulinidae RHUMBLER, 1913, p. 339 [*nom. van.*].

Family Artextulidia RHUMBLER, 1913, p. 342 [*nom. van.*].

Test free or attached, may have early planispiral coil. generally biserial and may become uniserial; wall agglutinated; aperture simple, basal or terminal, single to multiple.

Subfamily SPIROPLECTAMMININAE Cushman, 1927

Subfamily Spiroplectammininae CUSHMAN, 1927, p. 21.

Early stage planispiral, later biserial.

Subfamily TEXTULARIINAE Ehrenberg, 1839

Subfamily Textulariinae CHAPMAN, 1900a, p. 9 [*nom. correct. pro* subfamily Textularinae Carpenter, Parker & Jones, 1862].

Subfamily Textilarida SCHULTZE, 1854, p. 52 [*nom. transl. ex* family Textilarina Agassiz, 1844].

Subfamily Textularinae CARPENTER, PARKER & JONES, 1862, p. 189 [*nom. transl. ex* family Textularina Ehrenberg, 1839].

Subfamily Textilaridae SCHWAGER, 1877, p.

21 [*nom. correct. pro* subfamily Textilarida Schultze, 1854].

Subfamily Textilaria MARRIOTT, 1878, p. 30 [*nom. correct. pro* subfamily Textilarida Schultze, 1854].

Subfamily Textularidae BÜTSCHLI *in* Bronn, 1880, p. 203 [*nom. correct. pro* subfamily Textularinae Carpenter, Parker & Jones, 1862].

Subfamily Textilariinae JONES, 1895, p. 141 [*nom. correct. pro* subfamily Textilarida Schultze, 1854].

Test biserial, at least in the early stage, may become uniserial.

Subfamily PSEUDOBOLIVININAE Wiesner, 1931

Subfamily Pseudobolivininae WIESNER, 1931, p. 98.

Test biserial, aperture an elongate terminal slit or may be produced on a neck.

Subfamily TAWITAWIINAE Loeblich & Tappan, *subfam. nov.*

Biserial, with vertical pillars subdividing the chambers; aperture multiple, terminal. type genus: *Tawitawia* Loeblich, 1952.

Family TROCHAMMINIDAE Schwager, 1877

Family Trochamminidae LISTER *in* Lankester, 1903, p. 142 [*nom. correct. pro* family Trochamminidea Schwager, 1877].

Family Trochamminidea SCHWAGER, 1877, p. 21.

Family Arenacea BÜTSCHLI *in* Bronn, 1880, p. 193 [*nom. nud.*].

Subfamily Trochammininae BRADY, 1884, p. 66 [*nom. transl. ex* family Trochamminidea Schwager, 1877].

Family Trochammina LANKESTER, 1885, p. 847 [*nom. correct. pro* family Trochamminidea Schwager, 1877].

Family Trochamminae DELAGE & HÉROUARD, 1896, p. 133 [*nom. correct. pro* family Trochamminidea Schwager, 1877].

Family Dischistidae EIMER & FICKERT, 1899, p. 678 (*partim*) [*nom. nud.*].

Family Artrochammidia RHUMBLER, 1913, p. 342 [*nom. van. pro* family Trochamminidea Schwager, 1877].

Subfamily Ammosphaeroidininae CUSHMAN, 1927, p. 40.

Subfamily Globotextulariinae CUSHMAN, 1927, p. 40.

Family Trochamminida COPELAND, 1956, p. 186 [*nom. van.*].

Test free or attached, trochospiral; wall agglutinated, interior simple; aperture interiomarginal or areal.

Family ATAXOPHRAGMIIDAE Schwager, 1877

Family Ataxophragmiidae GALLOWAY & HEMINWAY, 1941, p. 320 [*nom. correct. pro* family Ataxophragmidea Schwager, 1877].

Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.*].

Family Uvellina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Family Turbinoidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 (*partim*) [*nom. nud.*].

Family Turbinoida SCHULTZE, 1854, p. 52 (*partim*) [*nom. correct. pro* family Turbinoidae d'Orbigny, 1839, *nom. nud.*].

Family Helicostegia REUSS, 1860, p. 151, 205 (*partim*) [*nom. correct. pro* family Hélicostègues d'Orbigny, 1826, *nom. nud.*]

Family Uvellidae REUSS, 1860, p. 203 (*partim*) [*nom. correct. pro* family Uvellina Ehrenberg, 1839, *nom. nud.*].

Family Uvellidea REUSS, 1862, p. 318, 382 (*partim*) [*nom. correct. pro* family Uvellina Ehrenberg, 1839, *nom. nud.*].

Family Uvellideae GÜMBEL, 1868, p. 23 (*partim*) [*nom. correct. pro* family Uvellina Ehrenberg, 1839, *nom. nud.*].

Family Ataxophragmidea SCHWAGER, 1877, p. 22.

Family Turbinida MARRIOTT, 1878, p. 30 (*partim*) [*nom. correct. pro* family Turbinoida Schultze, 1854, *nom. nud.*].

Family Valvulinidae BERTHELIN, 1880, p. 16.

Family Trischistidae EIMER & FICKERT, 1899, p. 680 [*nom. nud.*].

Family Opistho-Trischistidae EIMER & FICKERT, 1899, p. 680 [*nom. nud.*].

Family Textulinidae RHUMBLER, 1913, p. 339 (*partim*) [*nom. van.*].

Family Verneuilinidae CUSHMAN, 1927, p. 25 [*nom. transl. ex* subfamily Verneuilininae Cushman, 1911].

Family Eggerellidae HOFKER, 1957, p. 35 [*nom. transl. ex* subfamily Eggerellinae Cushman, 1937].

Test free, trochospiral, uncoiling or uniserial; wall agglutinated; aperture a

basal slit in the early stage, later may become terminal, cribrate or toothed.

Subfamily VERNEUILININAE Cushman, 1911

Subfamily Verneuilininae CUSHMAN, 1911, p. 52.

Subfamily Uvellida SCHULTZE, 1854, p. 52 (*partim*) [*nom. transl. ex* family Uvellina Ehrenberg, 1839, *nom. nud.*].

Subfamily Spiroplectininae CUSHMAN, 1927, p. 62.

Subfamily Spiroplectinatinae CUSHMAN, 1928a, p. 235 [*nom. subst. pro* subfamily Spiroplectininae Cushman, 1927].

Triserial in early stage, later biserial or uniserial in some forms; number of chambers per whorl tends to decrease with growth; aperture simple.

Subfamily EGGERELLINAE Cushman, 1937

Subfamily Eggerellinae CUSHMAN, 1937, p. 30.

Test trochoid, three or more chambers per whorl, number of chambers per whorl tends to decrease with growth, to three, two or one; aperture toothed or cribrate.

Subfamily ATAXOPHRAGMIINAE Schwager, 1877

Subfamily Ataxophragmiinae GALLOWAY, 1933, p. 211 [*nom. transl. ex* family Ataxophragmidea Schwager, 1877].

Early stage with three or more chambers per whorl, increasing in number per whorl with growth, or uncoiling and spreading to form low conical test; may have internal pillars and partitions.

Subfamily VALVULININAE Berthelin, 1880

Subfamily Valvulininae SCHUBERT, 1920, p. 179 [*nom. transl. ex* family Valvulinidae Berthelin, 1880].

Subfamily Uvellida SCHULTZE, 1854, p. 52 (*partim*) [*nom. transl. ex* family Uvellina Ehrenberg, 1839, *nom. nud.*].

Three chambers in early whorls, later increasing in number or becoming uniserial; aperture an interiomarginal slit, may have valvular tooth or become terminal or cribrate.

Subfamily PAVONITININAE Loeblich & Tappan, *subfam. nov.*

Early stage triserial, later uniserial, secondary septa or vertical pillars projecting downward from the chamber roof. Type genus: *Pavonitina* Schubert, 1914.

Superfamily PARATHURAMMINACEA Bykova, 1955, *nom. correct.*

Superfamily Parathuramminacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Parathuramminidea Fursenko, 1959].

Superfamily Parathuramminidea FURSENKO in Rauser-Chernousova & Fursenko, 1959, p. 174 [*nom. transl. ex* family Parathuramminidae Bykova, 1955].

Single globular or tubular chamber, or cluster of such chambers; wall simple, consisting of calcareous granules in calcareous cement; aperture simple.

Family PARATHURAMMINIDAE Bykova, 1955

Family Parathuramminidae BYKOVA *in* Bykova & Polenova, 1955, p. 15.

Family Archaesphaeridae MALACHOVA, 1956 p. 87.

Globular chamber, or cluster of chambers; aperture absent or multiple at the ends of tubular projections.

Family CALIGELLIDAE Reitlinger, 1959

Family Caligellidae REITLINGER *in* Rauser-Chernousova & Fursenko, 1959, p. 175.

Test tubular or enrolled, may have irregular constrictions or projections from the wall, tending to become septate in advanced forms; aperture simple or irregular.

Family MORAVAMMINIDAE Pokorný, 1951, *nom. transl.*

Family Moravamminidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Moravammininae Pokorný, 1951].

Family Earlandiidae CUMMINGS, 1955b, p. 227.

Test globular to tubular and non-septate, free or attached; aperture simple and terminal.

Subfamily EARLANDIINAE Cummings, 1955

Subfamily Earlandiinae POKORNÝ, 1958, p. 169 [*nom. transl. ex* family Earlandiidae Cummings, 1955].

Test free, tubular or uniserial.

Subfamily MORAVAMMININAE Pokorný, 1951

Subfamily Moravamminidae POKORNÝ, 1951, p. 7.

Test attached, tubular.

Superfamily ENDOTHYRACEA Brady, 1884, *nom. correct.*

Superfamily Endothyracea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Endothyridea Glaessner, 1945].

Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 685 (*partim*) [*nom. nud.*].

Suborder Imperforina CALKINS, 1901, p. 106 (*partim*).

Basistoma SCHUBERT, 1920, p. 148 (*partim*).

Family Group Archi-Monothalamidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 85 (*partim*).

Family Group Nodosalidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 86 (*partim*).

Family Group Rotaliaridia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88 (*partim*).

Family Group Textulinidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88 (*partim*).

Order Nodosaridia KÜHN, 1926, p. 134 (*partim*).

Order Rotaliaridia KÜHN, 1926, p. 152 (*partim*).

Order Textulinida CALKINS, 1926, p. 356 (*partim*).

Order Nodosalidia CALKINS, 1926, p. 355 (*partim*).

Order Hellenoidea WEDEKIND, 1937, p. 79 (*partim*).

Suborder Cribrostomacea WEDEKIND, 1937, p. 79.

Suborder Cribrospiracea WEDEKIND, 1937, p. 79.

Superfamily Endothyridea GLAESSNER, 1945, p. 107 [*nom. transl. ex* subfamily Endothyrinae Brady, 1884].

Order Endothyrida FURSENKO, 1958, p. 23.

Superfamily Tournayellidea DAIN in Rauser-Chernousova & Fursenko, 1959, p. 183 [*nom. transl. ex* family Tournayellidae Dain, 1953].

Tubular or with early trochospiral or irregular coil, biserial or uniserial; interior may be divided into chamberlets, but not labyrinthic; wall calcareous, fibrous or granular, with some arenaceous material included in primitive forms, commonly with two layers to the wall, finely perforate; aperture simple to multiple, basal or terminal.

Family NODOSINELLIDAE Rhumbler, 1895

Family Nosinellidae RHUMBLER, 1895b, p. 85.

Family Nodosamminidae RHUMBLER, 1913, p. 339 (*partim*) [*nom. nud.*].

Family Nodosinellida COPELAND, 1956, p. 186 [*nom. van.*].

Family Tuberitinidae MIKLUKHO-MAKLAI, 1958b, p. 134.

Test tubular or uniserial; wall structure compound, of microgranular calcite with inner fibrous layer.

Subfamily TUBERITININAE Miklukho-Maklai, 1958, *nom. transl.*

Subfamily Tuberitininae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Tuberitinidae Miklukho-Maklai, 1958b].

Test attached, consisting of one or more subhemispherical chambers; no distinct aperture.

Subfamily UMBELLININAE Loeblich & Tappan, *nom. nov.*

Subfamily Umbellininae LOEBLICH & TAPPAN, herein [*nom. subst. pro* subfamily Umbellinae Fursenko, *nom. nud.*].

Subfamily Umbellinae FURSENKO *in* Rauser-Chernousova & Fursenko, 1959, p. 248 [*nom. nud.*, based on *Umbella* Maslov, 1955, not *Umbella* d'Orbigny, 1841, Mollusca.].

Test free, globular or flask-shaped. Type genus: *Umbellina* Loeblich & Tappan, *nom. nov.*

Remarks.—*Umbellina* Loeblich & Tappan, *nom. nov.* is herein proposed for *Umbella* Maslov, 1955 (*in* Bykova, E., & Polenova, E. N., Trudy VNIGRI, v. 87, p. 37), not *Umbella* d'Orbigny, 1841, Mollusca. Type species, *Umbellina bella* (Maslov) = *Umbella bella* Maslov, 1955.

The subfamily was defined by Fursenko to include also *Cochleatina* Bykova, 1956 and *Illigata* Bykova, 1956. *Cochleatina* is a bryozoan, and synonymous with the genus

Corynotrypa Bassler, 1911, and *Illigata* may also be a bryozoan. These two genera are attached and thin-walled perforate forms which are quite distinct from the flask-shaped thick radially fibrous-walled *Umbellina*, with large round terminal aperture. Originally considered as a subfamily of the Lagenidae (=Nodosariidae), the Umbellininae are here removed to the Nodosinellidae, because of the fibrous structure of the thick walls.

Subfamily NODOSINELLINAE Rhumbler, 1895, *nom. transl.*

Subfamily Nodosinellinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Nodosinellidae Rhumbler, 1895].

Test free, uniserial; wall compound, of microgranular calcite and inner fibrous layer.

Family COLANIELLIDAE Fursenko, 1959, *nom. transl.*

Family Colaniellidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Colaniellinae Fursenko, 1959].

Subfamily Colaniellinae FURSENKO, *in* Rauser-Chernousova & Fursenko, 1959, p. 251.

Test uniserial, chambers strongly overlapping, internally subdivided by vertical radial partitions; wall of two layers, inner layer finely granular, outer layer vitreous; aperture rounded to radiate.

Family PTYCHOCLADIIDAE Elias, 1950

Family Ptychocladiidae ELIAS, 1950, p. 288.

Test attached, uniserial and branching or spreading; wall granular calcareous, banded, with transverse tubuli; no distinct aperture.

Subfamily PTYCHOCLADIINAE Elias, 1950, *nom. transl.*

Subfamily Ptychocladiinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Ptychocladiidae Elias, 1950].

Test uniserial and dichotomously branching, or with branches laterally fused to become discoidal.

Subfamily STACHEIINAE Loeblich & Tappan, *subfam. nov.*

Test attached, spreading, with chambers in sheetlike layers. Type genus: *Stacheia* Brady, 1876.

Family PALAEOTEXTULARIIDAE Galloway, 1933

Family Palaeotextulariidae WEDEKIND, 1937, p. 79 [*nom. transl. ex* subfamily Palaeotextulariinae Galloway, 1933].

Family Dischistidae EIMER & FICKERT, 1899, p. 678 (*partim*) [*nom. nud.*].

Family Opistho-Dischistidae EIMER & FICKERT, 1899, p. 677 (*partim*) [*nom. nud.*].

Subfamily Palaeotextulariinae GALLOWAY, 1933, p. 221.

Family Cribrostomatidae WEDEKIND, 1937, p. 79 [*nom. van.*].

Test biserial or may become uniserial; wall granular calcareous, with inner fibrous layer and thin adventitious coating; aperture simple or multiple.

Family SEMITEXTULARIIDAE Pokorný, 1956

Family Semitextulariidae POKORNÝ, 1956, p. 284.

Family Pseudopalmulidae BYKOVA *in* Rauser-Chernousova & Fursenko, 1959, p. 264.

Test biserial or many become uniserial, compressed, chambers simple or with vertical partitions; aperture multiple.

Family TETRATAXIDAE Galloway, 1933

Family Tetrataxidae POKORNÝ, 1958, p. 199 [*nom. transl. ex* subfamily Tetrataxinae Galloway, 1933].

Subfamily Tetrataxinae GALLOWAY, 1933, p. 161.

Subfamily Tetrataxiinae REITLINGER, 1950, p. 71 [*nom. correct. pro* subfamily Tetrataxinae Galloway, 1933].

Test free, trochospiral, few chambers per whorl, conical; wall granular calcareous, in two layers.

Family BISERIAMMINIDAE Chernysheva, 1941

Family Biseriamminidae CHERNYSHEVA, 1941, p. 70.

Subfamily Globivalvulinae REITLINGER, 1950, p. 75.

Subfamily Globivavulininae POKORNÝ, 1958 p. 200 [*nom. correct. pro* subfamily Globivalvulinae Reitlinger, 1950].

Test enrolled biserial, involute; aperture at inner border of septal face.

Family TOURNAYELLIDAE Dain, 1953

Family Tournayellidae DAIN in Dain & Grozdilova, 1953, p. 16.

Subfamily Glomospirellinae REITLINGER, 1950, p. 26 [*nom. nud.;* based on *Glomospirella* Reitlinger 1950, not *Glomospirella* Plummer, 1945].

Subfamily Tournayellinae DAIN *in* Dain & Grozdilova, 1953, p. 20.

Subfamily Forschiinae DAIN *in* Dain & Grozdilova, 1953, p. 38.

Family Forschiidae GROZDILOVA & LEBEDEVA, 1954, p. 36 [*nom. transl. ex* subfamily Forschiinae Dain, 1953].

Subfamily Forshiinae REITLINGER, 1953, p. 60 [*nom. null.*].

Family Teurnayellidae REITLINGER, 1958, p. 60 (*nom. null.*].

Test free, proloculus followed by planispirally enrolled tubular second chamber, subseptate, with slight protruberances or incipient septa forming pseudochambers; wall calcareous, granular, and may have agglutinated inclusions; aperture simple or cribrate.

Family ENDOTHYRIDAE Brady, 1884

Family Endothyridae RHUMBLER, 1895b, p. 92 [*nom. correct. pro* family Endothyrina Lankester, 1885].

Family Endothyrina LANKESTER, 1885, p. 847 [*nom. transl. ex* subfamily Endothyrinae Brady, 1884].

Family Endothyrinae DELAGE & HÉROUARD, 1896, p. 133 [*nom. correct. pro* family Endothyrina Lankester, 1885].

Family Cribrospiridae WEDEKIND, 1937, p. 79.

Family Plectogyridae POYARKOV, 1957, p. 29.

Family Bradyinidae REITLINGER, 1958, p. 57 [*nom. transl. ex* subfamily Bradyininae Reitlinger, 1950].

Test enrolled, planispiral or plectogyral; aperture simple or multiple.

Subfamily LOEBLICHIINAE Cummings, 1955, *nom. correct.*

Subfamily Loeblichiinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Loeblichinae Cummings, 1955].

Subfamily Loeblichinae CUMMINGS, 1955a, p. 3.

Subfamily Nanicellinae FURSENKO *in* Rauser-Chernousova & Fursenko, 1959, p. 252.

Test planispiral, compressed, involute or evolute; chambers numerous; aperture basal.

Subfamily ENDOTHYRINAE Brady, 1884

Subfamily Endothyrinae BRADY, 1884, p. 66.

Test planispiral, not compressed; wall of granular calcite and non-porous, aperture basal.

Subfamily PLECTOGYRINAE Poyarkov, 1957

Subfamily Plectogyrinae REITLINGER, 1958, p. 57 [*nom. transl. ex* family Plectogyridae Poyarkov, 1957].

Subfamily Chernyshinellinae REITLINGER, 1958, p. 60.

Subfamily Haplophragmellinae REITLINGER *in* Rauser-Chernousova & Fursenko, 1959 p. 185.

Coiling streptospiral, may uncoil in later stages, incompletely septate; wall calcareous, may have calcareous agglutinated material in addition; aperture single to multiple.

Subfamily ENDOTHYRANOPSINAE Reitlinger, 1958

Subfamily Endothyranopsinae REITLINGER, 1958, p. 57.

Test planispiral, involute, not compressed, distinctly septate; wall of thick granular calcite with some adventitious material; aperture basal.

Subfamily BRADYININAE Reitlinger, 1950

Subfamily Bradyininae REITLINGER, 1950, p. 38.

Test planispiral, involute; wall of granular calcite, complex interior; chambers alternating with small chamberlets, which are visible externally by the row of openings along the sutures; aperture multiple, areal and interiomarginal.

Family ARCHAEDISCIDAE Cushman, 1928

Family Archaediscidae CHERNYSHEVA, 1948, p. 151 [*nom. transl. ex* subfamily Archaediscinae Cushman, 1928].

Subfamily Archaediscinae CUSHMAN, 1928a, p. 209.

Subfamily Asteroarchaediscinae MIKLUKHO-MAKLAI, 1957a, p. 37.

Proloculus followed by tubular second chamber, involute in early stage, later streptospirally or planispirally coiled; outer wall layer of radial calcite, inner layer finely granular; aperture at end of spiral chamber.

Family LASIODISCIDAE Reitlinger, 1956

Family Lasiodiscidae REITLINGER, 1956, p. 74.

Test planispiral to conical, proloculus followed by unsegmented tubular chamber; wall calcareous, with microgranular layer and radially built vitreous layer, the latter concentrated as umbilical fillings perforated by canal-like fissures in advanced forms, but consisting only of bridges across the spiral suture in simple forms; aperture at the open end of the tubular chamber, with supplementary sutural openings.

Superfamily FUSULINACEA Möller, 1878, *nom. correct.*

Superfamily Fusulinacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Fusulinoidea Ciry, 1952].

Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 685 (*partim*) [*nom. nud.*].

Suborder Tinoporinae CALKINS, 1901, p. 109, (*partim*).

Family Group Rotaliaridia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88 (*partim*).

Order Hellenoidea WEDEKIND, 1937, p. 79 (*partim*).

Suborder Fusulinacea WEDEKIND, 1937, p. 79.

Suborder Pluriloculinidea SIGAL *in* Piveteau, 1952, p. 160 (*partim*).

Superfamily Fusulinoidea CIRY *in* Piveteau, 1952, p. 179 [*nom. transl. ex* family Fusulinidae Möller, 1878].

Superfamily Fusulinaceae MIKLUKHO-MAKLAI, 1957b, p. 96 [*nom. correct. pro* superfamily Fusulinoidea Ciry, 1952].

Superfamily Neoschwagerinaceae MIKLUKHO-MAKLAI, 1957b, p. 109 [*nom. transl. ex* subfamily Neoschwagerininae Dunbar & Condra, 1927].

Order Fusulinida FURSENKO, 1958, p. 23.

Superfamily Fusulinidea POKORNÝ, 1958, p. 220 [*nom. correct. pro* superfamily Fusulinoidea Ciry, 1952].

Superfamily Verbeekinaceae MIKLUKHO-MAKLAI, 1958a, p. 7 [*nom. transl. ex* subfamily Verbeekininae Staff & Wedekind, 1910].

Superfamily Verbeekinidea MIKLUKHO-MAKLAI, RAUSER-CHERNOUSOVA & ROSOVSKAYA, 1958, p. 17 [*nom. correct. pro* superfamily Verbeekinaceae Miklukho-Maklai, 1958].

Test fusiform to subcylindrical, with numerous broad, low planispirally coiled chambers; wall calcareous, perforate, primitively with 4 distinct layers, primary layer (protheca) consisting of a clear inner diaphanotheca and thin dark outer tectum, and a secondary layer (epitheca) consisting of the translucent tectorium added over roof, sides and floor of earlier formed chambers (inner and outer tectoria); more advanced forms have wall reduced to tectum and alveolar layer (keriotheca) which is analogous to the diaphanotheca; aperture absent or represented by interiomarginal row of septal pores.

Family FUSULINIDAE Möller, 1878

Family Fusulinidae MÖLLER, 1878, p. 133.

Family Nautiloida SCHULTZE, 1854, p. 53 (*partim*) [*nom. nud.*].

Family Fusulinina LANKESTER, 1885, p. 848 [*nom. correct. pro* family Fusulinidae Möller, 1878].

Family Fusulininae DELAGE & HÉROUARD, 1896, p. 148 [*nom. correct. pro* family Fusulinidae Möller, 1878].

Family Fusilinidae CALKINS, 1926, p. 356 [*nom. null.*].

Family Schwagerinidae DUNBAR & HENBEST, 1930, p. 363.

Family Fusulinida COPELAND, 1956, p. 188 [*nom. van.*].

Family Staffellinidae MIKLUKHO-MAKLAI, 1957b, p. 96 [*nom. transl. ex* subfamily Staffellinae Miklukho-Maklai, 1949].

Family Staffellidae MIKLUKHO-MAKLAI, 1958a, p. 11 [*nom. correct. pro* family Staffellinidae Miklukho-Maklai, 1957],

Family Ozawainellidae MILKUKHO-MAKLAI, 1958a, p. 13 [*nom. transl. ex* subfamily Ozawainellinae Thompson & Foster, 1937].

Family Schubertellidae MIKLUKHO-MAKLAI

RAUSER-CHERNOUSOVA & ROZOVSKAYA, 1958, p. 17 [*nom. transl. ex* subfamily Schubertellinae Skinner, 1931].

Family Schubertellinidae MIKLUKHO-MAKLAI, RAUSER-CHERNOUSOVA & ROZOVSKAYA, 1958, fig. 2 on p. 7 [*nom. null. pro* family Schubertellidae Miklukho-Maklai, Rauser-Chernousova & Rozovskaya, 1958].

Test fusiform to subcylindrical, planispiral, primitively with short axis, later forms becoming elongate, aberrantly becoming evolute or irregular; septa formed by inflections of the wall, septal folds common; median tunnel formed by resorption of basal margin of septa, bordered by chomata in early forms; spiral wall calcareous and perforate; no true aperture, but minute septal pores occur in antetheca.

Subfamily OZAWAINELLINAE Thompson & Foster, 1937

Subfamily Ozawainellinae THOMPSON & FOSTER, 1937, p. 132.

Subfamily Staffellininae MIKLUKHO-MAKLAI, 1949, p. 46.

Subfamily Staffellinae ROZOVSKAYA, 1950, p. 378 [*nom. correct. pro* subfamily Staffellininae Miklukho-Maklai, 1949].

Subfamily Pseudostaffellinae PUTRYA, 1956, p. 395.

Subfamily Staffelininae POKORNÝ, 1958, p. 233 [*nom. van. pro* subfamily Staffellininae Miklukho-Maklai, 1949].

Subfamily Reichelininae MIKLUKHO-MAKLAI, 1959, p. 630.

Shell minute, short axis of coiling, involute or evolute, may be discoidal, periphery angular during part of growth; tunnel low, chomata throughout test; spirotheca with tectum, upper and lower tectoria, and diaphanotheca below tectum in advanced genera.

Subfamily FUSULININAE Möller, 1878

Subfamily Fusulininae BRADY, 1884, p. 74 [*nom. correct. pro* subfamily Fusulinidae Bütschli, 1880].

Subfamily Fusulinidae BÜTSCHLI *in* Bronn, 1880, p. 213 [*nom. transl. ex* family Fusulinidae Möller, 1878].

Subfamily Fusulinellinae STAFF & WEDEKIND, 1910, p. 112.

Subfamily Pseudotriticitinae PUTRYA, 1948, p. 97.

Subfamily Quasifusulininae PUTRYA, 1956, p. 467.

Subfamily Hemifusulininae PUTRYA, 1956, p. 467.

Subfamily Eofusulininae RAUSER-CHERNOUSOVA & ROZOVSKAYA *in* Miklukho-Maklai, Rauser-Chernousova & Rozovskaya, 1958, p. 17.

Axis of coiling elongate, early forms with three layers in the wall, later ones with four layers (including diaphanotheca), more advanced forms lack the tectoria; single tunnel, chomata distinct, may have heavy axial fillings, septal fluting variable.

Subfamily SCHUBERTELLINAE Skinner, 1931

Subfamily Schubertellinae SKINNER, 1931, p. 257.

Subfamily Boultoniinae SKINNER & WILDE, 1954, p. 437.

Subfamily Schubertellininae ROZOVSKAYA, 1950, p. 376 [*nom. van. pro* subfamily Schubertellinae Skinner, 1931].

Test elongate fusiform, irregular to straight axis of coiling; primitive forms with tectum, upper and lower tectoria, advanced forms also have diaphanotheca; septa straight in early forms, later ones are fluted in polar regions, and in advanced genera septa are completely fluted.

Subfamily SCHWAGERININAE Dunbar & Henbest, 1930

Subfamily Schwagerininae YABE & HANZAWA, 1932, p. 42 [*nom. iransl. ex* family Schwagerinidae Dunbar & Henbest, 1930].

Subfamily Pseudofusulininae DUTKEVICH, 1934, p. 53.

Subfamily Polydiexodininae A. D. MIKLUKHO-MAKLAI, 1947 (*fide* A. D. Miklukho-Maklai, 1953, p. 21).

Test fusiform, with straight to slightly irregular axis of coiling; planispiral and involute except that advanced forms may become irregular in the outer volutions; septa fluted; wall with tectum and keriotheca, with well developed alveoli.

Family VERBEEKINIDAE Staff & Wedekind, 1910

Family Verbeekinidae MIKLUKHO-MAKLAI, 1957b, p. 110 [*nom. transl. ex* subfamily

Verbeekininae Staff & Wedekind, 1910].

Family Neoschwagerinidae DUNBAR *in* Cushman, 1948, p. 164 [*nom. transl. ex* subfamily Neoschwagerininae Dunbar & Condra, 1927].

Septa plane with linear septula protruding from the spirotheca; wall of two layers, outer tectum and inner alveolar keriotheca; aperture consists of row of openings at base of antetheca, which remain as interchamber openings.

Subfamily VERBEEKININAE Staff & Wedekind, 1910

Subfamily Verbeekininae STAFF & WEDEKIND, 1910, p. 114.

Subfamily Doliolininae GUBLER, 1935, p. 9.

Subfamily Miselininae MIKLUKHO-MAKLAI, 1958a, p. 9.

Test subspherical, axis of coiling straight; wall with tectum and thicker alveolar lower layer, dense discontinuous growths on both surfaces of inner volutions; septa not fluted, no septula; row of foramina at base of septa in outer volutions, or throughout.

Subfamily NEOSCHWAGERININAE Dunbar & Condra, 1927

Subfamily Neoschwagerininae DUNBAR & CONDRA, 1927, p. 74.

Axis of coiling elongate; wall with tectum and thick lower layer in early forms, later ones with only a single dense layer; foramina and parachomata present; transverse septula and advanced forms have axial septula also.

Subfamily SUMATRININAE Kahler & Kahler, 1946

Subfamily Sumatrininae KAHLER & KAHLER, 1946, p. 170.

Subfamily Lepidolininae MIKLUKHO-MAKLAI, 1958a, p. 10.

Wall with a single homogeneous layer; septula are compact plates.

Superfamily MILIOLACEA Ehrenberg, 1839, *nom. correct.*

Superfamily Miliolacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Miliolidea Glaessner, 1945 and Miliolicae Easton, 1960].

Tribu Milleporita LATREILLE, 1825, p. 166 (*partim*).

Tribu Orthocerata LATREILLE, 1825, p. 162 (*partim*).

Tribu Polycyclica LATREILLE, 1825, p. 164 (*partim*).

Suborder Monosomatia EHRENBERG, 1839, table opposite p. 120 (*partim*).

Order Agathistègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 153 [*nom. neg.*].

Order Éntomostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 113 [*nom. neg.*].

Order Cyclostègues D'ORBIGNY, 1851, p. 192 (*partim*) [*nom. neg.*].

Group Helicoidea SCHULTZE, 1854, p. 53.

Monothalamia SCHULTZE, 1854, p. 52 (*partim*).

Nautiloidea REUSS, 1860, p. 151 (*partim*) [*nom. transl. ex* family Nautiloidae d'Orbigny, 1839].

Suborder Imperforata CARPENTER, PARKER & JONES, 1862, p. 62.

Foraminifera Monomera REUSS, 1862, p. 362 (*partim*).

Foraminifera Polymera REUSS, 1862, p. 365 (*partim*).

Group Imperforata CLAUS, 1872, p. 108.

Division Monothalamia MARRIOTT, 1878, p. 30 (*partim*).

Order Miliolidea LANKESTER, 1885, p. 846.

Subclass Imperforata LANKESTER, 1885, p. 845 (*partim*).

Order Monothalamia HAECKEL, 1894, p. 164 (*partim*).

Order Polystegia HAECKEL, 1894, p. 164 (*partim*).

Order Imperforida DELAGE & HÉROUARD, 1896, p. 107.

Suborder Miliolidae DELAGE & HÉROUARD, 1896, p. 117.

Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 185 (*partim*) [*nom. nud.*].

Suborder Imperforina CALKINS, 1901, p. 106 (*partim*).

Order Miliolidaceae HARTOG *in* Harmer & Shipley, 1906, p. 59.

Order Miliolida CALKINS, 1909, p. 39.

Family Group Archi-Monothalamidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 85 (*partim*).

Family Group Flexostylidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 87 (*partim*).

Order Flexostylidia CALKINS, 1926, p. 355 (*partim*).

Order Flexostili (Imperforata) SILVESTRI, 1937, p. 77.

Order Hellenoidea WEDEKIND, 1937, p. 79 (*partim*).

Order Cornuspiroidea WEDEKIND, 1937, p. 87.

Suborder Cristellariacea WEDEKIND, 1937, p. 93 (*partim*).

Suborder Orbitolitacea WEDEKIND, 1937, p. 120.

Superfamily Miliolidea GLAESSNER, 1945, p. 116 [*nom. transl. ex* family Miliolina Ehrenberg, 1839].

Suborder Biloculinidea SIGAL *in* Piveteau, 1952, p. 157 (*partim*).

Suborder Pluriloculinidea SIGAL *in* Piveteau, 1952, p. 160 (*partim*).

Suborder Cornuspiridea JÍROVEC, 1953, p. 335.

Superfamily Alveolinidea VOLOSHINOVA *in* Rauser-Chernousova & Fursenko, 1959, p. 244 [*nom. transl. ex* family Alveolinea Ehrenberg, 1839].

Superfamily Miliolicae EASTON, 1960, p. 65, 76 [*nom. correct. pro* superfamily Miliolidea Glaessner, 1945].

Wall porcellanous, commonly with chitinous inner lining, and may have advantitious material on exterior, imperforate at least in post-embryonic stages; proloculus with spiral passage followed by numerous chambers which may be planispirally coiled or arranged in definite planes; aperture terminal, single or cribrate and may be variously modified.

Family NUBECULARIIDAE Jones, 1875

Family Nubeculariidae AVNIMELECH & REISS *in* Avnimelech, Parness & Reiss, 1954, p. 838 [*nom. correct. pro* family Nubecularida Jones, 1875, and Nubecularidae Lister, 1903].

Family Inequilateralidae D'ORBIGNY *in* de la Sagra, 1839, p. 26 [*nom. nud.*].

Family Inaequilateralidae D'ORBIGNY, 1846, p. 73 [*nom. correct. pro* family Inequilateralidae d'Orbigny, 1839, *nom. nud.*].

Family Cornuspirida SCHULTZE, 1854, p. 52.

Family Cornuspiridae REUSS, 1860, p. 177 [*nom. correct. pro* family Cornuspirida Schultze, 1854].

Family Cornuspiridea REUSS, 1862, p. 364, 394 [*nom. correct. pro* family Cornuspiridae Reuss, 1860].

Family Cornuspirideae GÜMBEL, 1868, p. 26 [*nom. correct. pro* family Cornuspirida Schultze, 1854].

Family Nubecularida JONES *in* Griffith & Henfrey, 1875, p. 319.

Family Ovulinetta HAECKEL, 1894, p. 164 [*nom. nud.*].

Family Nubecularina LANKESTER, 1885, p. 846 [*nom. correct. pro* family Nubecularida Jones, 1875].

Family Nubecularinae DELAGE & HÉROUARD, 1896, p. 122 [*nom. correct. pro* family Nubecularida Jones, 1875].

Family Nubeculariidae LISTER *in* Lankester, 1903, p. 143 [*nom. correct. pro* family Nubecularinae Delage & Hérouard, 1896].

Family Opthalmidiidae CUSHMAN, 1927, p. 36.

Family Ophthalmidiidae CUSHMAN, 1928, p. 159 [*nom. correct. pro* family Opthalmidiidae Cushman, 1927].

Family Fischerinidae CUSHMAN, 1927, p. 40 [*nom. transl. ex* subfamily Fischerininae Cushman, 1919].

Family Ophtalmidiidae LECALVEZ, 1935, p. 96 [*nom. van. pro* family Ophthalmidiidae Cushman, 1928].

Family Ophthalmididae DOGEL, 1951, p. 464 [*nom. van. pro* family Ophthalmidiidae Cushman, 1928].

Test free or attached, planispiral or irregularly coiled, at least in the early stages, later spreading or branched; aperture simple, rounded or slitlike or more rarely cribrate.

Remarks.—As the genus *Cornuspira* Schultze, 1854 is a junior synonym of *Cyclogyra* Wood, 1842, the subfamily Cornuspirinae Schultze, 1854 (*nom. transl.*, Rhumbler, 1904) is suppressed. The family Nubecularida Jones, 1875 is thus the next available family name, after suppression of the Cornuspirida Schultze, 1854, and the name was corrected by Lister, 1903 and Avnimelech & Reiss, 1954.

Subfamily CYCLOGYRINAE Loeblich & Tappan, *nom. nov.*

Subfamily Cyclogyrinae LOEBLICH & TAPPAN, herein [*nom. subst. pro* subfamily Cornuspirinae Rhumbler, 1904].

Subfamily Cornuspirinae RHUMBLER, 1904, p. 284 [*nom. transl. ex* family Cornuspirida Schultze, 1854].

Subfamily Arcornuspirinia RHUMBLER, 1913 p. 387 [*nom. van. pro* subfamily Cornuspirinae Rhumbler, 1904].

Subfamily Cornuspirininae CUSHMAN, 1919, p. 633 [*nom. van. pro* subfamily Cornuspirinae Rhumbler, 1904].

Proloculus followed by undivided second chamber; generally tubular and coiled, but adult variable; free or attached. Type genus: *Cyclogyra* Wood, 1842.

Remarks.—As the generic name *Cornuspira* Schultze, 1854 is a junior synonym of *Cyclogyra* Wood, 1842, the subfamily Cyclogyrinae is proposed as a *nomen substitutum* for Cornuspirinae Rhumbler, 1904.

Subfamily NUBECULARIINAE Jones, 1875

Subfamily Nubeculariinae CHAPMAN, 1901, p. 169 [*nom. correct. pro* subfamily Nubecularinae Brady, 1884].

Subfamily Nubecularinae BRADY, 1884, p. 61 [*nom. transl. ex* family Nubecularida Jones, 1875].

Subfamily Nubeculinellinae AVNIMELECH & REISS *in* Avnimelech, Parness & Reiss, 1954, p. 838.

Test attached, early stage coiled, later may be irregular.

Subfamily OPHTHALMIDIINAE Cushman, 1927

Subfamily Ophthalmidiinae CUSHMAN, 1928, p. 164 [*nom. correct. pro* subfamily Opthalmidiinae Cushman, 1927].

Subfamily Miliolidae holostreptae EIMER & FICKERT, 1899, p. 688 [*nom. nud.*].

Subfamily Opthalmidiinae CUSHMAN, 1927, p. 37.

Subfamily Planispirinellinae WIESNER, 1931, p. 58, 60, 69, 110.

Test free, proloculus and undivided planispirally coiled chamber followed by irregular later chambers.

Subfamily FISCHERININAE Cushman, 1919

Subfamily Fischerininae CUSHMAN, 1919, p. 636.

Few tubular chambers per whorl, in conical spire; aperture at open end of final chamber.

Subfamily SPIROLOCULININAE Wiesner, 1931

Subfamily Spiroloculininae WIESNER, 1931, p. 58, 59, 62, 102.

Proloculus followed by cornuspirine coil, adult chambers one-half coil in length; aperture commonly with phialine lip and with simple or bifid tooth.

Subfamily NODOBACULARIINAE Cushman, 1927

Subfamily Nodobacullariinae CUSHMAN, 1927, p. 36.

Subfamily Nodophthalmidiinae CUSHMAN, 1940, p. 179.

Early portion planispiral, later chambers uncoiling.

Remarks.—Macfadyen (1939, p. 6) stated that *Nodobacularia*, as based on the type species *Nubecularia tibia* Jones & Parker, 1860, is a synonym of *Bullopora* Quenstedt, 1856. He therefore proposed the genus *Nodophthalmidium*, with type species *Nodobacularia compressa* Rhumbler, for *Nodobacularia* of authors. On this basis, the subfamily Nodobacullariinae Cushman, 1927 was replaced by the subfamily Nodophthalmidiinae by Cushman (1940, p. 179). Restudy of the types of *Nubecularia tibia* in the British Museum (Natural History) and topotypes of *Bullopora rostrata* Quenstedt, by the writers, shows them to be distinct, hence the genus *Nodobacularia* is recognized as valid and the subfamily Nodobacullariinae is here reinstated.

Subfamily DISCOSPIRININAE Wiesner, 1931, *nom. correct.*

Subfamily Discospirininae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Discospiriniinae Wiesner, 1931].

Subfamily Discospiriniinae WIESNER, 1931, p. 60, 73.

Test discoidal, thin, proloculus followed by cornuspirine coil of several volutions, later chambers one-half coil in length and finally annular, may be incompletely divided into chamberlets; aperture a row of pores at the margin of the final chamber.

Family INVOLUTINIDAE Bütschli, 1880

Family Involutinidae SIGAL *in* Piveteau, 1952, p. 159 [*nom. transl. ex* subfamily Involutinae Bütschli, 1880].

Family Ventrolaminidae WEYNSCHENK, 1950, p. 17.

Test tubular and enrolled, with secondary deposits in the umbilical region on one or both sides; wall calcareous, microgranular.

Subfamily INVOLUTININAE Bütschli, 1880

Subfamily Involutininae THALMANN, 1935, p. 715 [*nom. correct. pro* subfamily Involutinae Bütschli, 1880].

Subfamily Involutinae BÜTSCHLI *in* Bronn, 1880, p. 209.

Subfamily Problematininae RHUMBLER, 1913, p. 389.

Subfamily Arproblematoia RHUMBLER, 1913, p. 389 [*nom. van. pro* subfamily Problematininae Rhumbler, 1913].

Secondary deposits in umbilical region on both sides of the test; aperture rounded, at the open end of the tube.

Subfamily VENTROLAMININAE Weynschenk, 1950, *nom. transl.*

Subfamily Ventrolamininae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Ventrolaminidae Weynschenk, 1950].

Test bilaterally symmetrical; chambers in an arcuate series without intercameral foramina; septa microgranular; chambers probably opening into the secondary spongy deposit at the inside of the curve; thick radially built calcareous deposit at the margin opposite the row of chambers.

Family MILIOLIDAE Ehrenberg, 1839

Family Miliolidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 160 [*nom. correct. pro* family Miliolina Ehrenberg, 1839].

Family Miliolina EHRENBERG, 1839, table opposite p. 120.

Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].

Family Agathistègues D'ORBIGNY, 1826, p. 297 [*nom. nud.; nom. neg.*].

Family Enthomostègues D'ORBIGNY, 1826, p. 304 (*partim*) [*nom. nud.; nom. neg.*].

Family Plicatilia EHRENBERG, 1839, table opposite p. 120 [*nom. nud.*].

Family Fabularina EHRENBERG, 1839, table opposite p. 120.

Family Helicosorina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Family Multiloculidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 169 [*nom. nud.*].

Family Rhizopodes DUJARDIN, 1841, p. 126, 240 (*partim*) [*nom. neg.; nom. nud.*].

Family Tubularina AGASSIZ, 1844, p. 10 [*nom. nud.*].

Family Miliolida SCHULTZE, 1854, p. 52 [*nom. correct. pro* family Miliolina Ehrenberg, 1839].

Family Nautiloida SCHULTZE, 1854, p. 53 (*partim*) [*nom. nud.*].

Family Miliolitidae PARKER, 1858, p. 53.

Family Miliolidea REUSS, 1862, p. 374 [*nom. correct. pro* family Miliolina Ehrenberg, 1839].

Family Miliolidee SCHWAGER, 1876, p. 476, 483 [*nom. correct. pro* family Miliolina Ehrenberg, 1839].

Family Hauerinidee SCHWAGER, 1876, p. 483.

Family Miliolidina BÜTSCHLI *in* Bronn, 1880, p. 189 [*nom. correct. pro* family Miliolina Ehrenberg, 1839].

Family Hauerinidae STEINMANN, 1881, p. 41 [*nom. correct. pro* family Hauerinidee Schwager, 1876].

Family Hauerinina LANKESTER, 1885, p. 846 [*nom. correct. pro* family Hauerinidee Schwager, 1876].

Family Milioletta HAECKEL, 1894, p. 164 [*nom. correct. pro* family Miliolina Ehrenberg, 1839].

Family Miliolinidae RHUMBLER, 1895b, p. 86 [*nom. transl. ex* subfamily Miliolininae Brady, 1881].

Family Miliolinae DELAGE & HÉROUARD, 1896, p. 122 [*nom. correct. pro* family Miliolina Ehrenberg, 1839].

Family Hauerinae DELAGE & HÉROUARD, 1896, p. 124 [*nom. correct. pro* family Hauerinidee Schwager, 1876].

Family Armiliolidia RHUMBLER, 1913, p. 341 [*nom. van. pro* family Miliolinidae Rhumbler, 1895].

Test free, septate, typically with two chambers per whorl arranged in varying planes about a longitudinal axis, may become rectilinear or involute, or may be subdivided into chamberlets; aperture terminal, simple or with spatulate or bifid tooth or cribrate.

Subfamily MILIOLINELLINAE Vella, 1957

Subfamily Miliolinellinae VELLA, 1957, p. 20.

Wall simple, with broad flat tooth or flap partially closing the aperture.

Subfamily QUINQUELOCULININAE Cushman, 1917

Subfamily Quinqueloculininae CUSHMAN, 1917, p. 41.

Subfamily Miliolidea genuina REUSS, 1862, p. 374 [*nom. nud.*].

Subfamily Miliolidae opisthostreptae EIMER & FICKERT, 1899, p. 687 [*nom. nud.*].

Subfamily Massilininées LACROIX, 1938, p. 1 [*nom. neg.*].

Subfamily Massillininae THALMANN, 1941, p. 682.

Subfamily Sigmoilopsinae VELLA, 1957, p. 18.

Wall simple, aperture with bifid tooth or modification of such.

Remarks.—Lacroix (1938, p. 1) proposed the subfamily Massilininées, which because of its vernacular (non-Linnaean) spelling constitutes invalid original spelling (*nomen negatum*), hence is not correctable to establish authorship and date. The citation of subfamily Massillininae Lacroix by Thalmann (1941, p. 682) is incorrect, as such valid spelling was not used by Lacroix. If recognized as distinct, the authorship and date of the subfamily Massillininae must therefore rest with Thalmann, 1941, as cited above.

Subfamily MILIOLINAE Ehrenberg, 1839

Subfamily Miliolinae RHUMBLER, 1895b, p. 87 [*nom. transl. ex* family Miliolina Ehrenberg, 1839].

Subfamily Miliolininae BRADY, 1881, p. 43.

Subfamily Hauerininae BRADY, 1884, p. 62 [*nom. transl. ex* family Haauerinidee Schwager, 1876].

Subfamily Trematoforininae SILVESTRI, 1937, p. 80 [*nom. nud.*].

Wall simple; with cribrate aperture (trematophore).

Subfamily FABULARIINAE Ehrenberg, 1839, *nom. correct.*

Subfamily Fabulariinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Fabularidea Reuss, 1862].

Subfamily Fabularidea REUSS, 1862, p. 375 [*nom. transl. ex* family Fabularina Ehrenberg, 1839].

Interior complex; chambers subdivided into chamberlets; aperture multiple.

Subfamily TUBINELLINAE Rhumbler, 1906

Subfamily Tubinellinae RHUMBLER, 1906, p. 25.

Subfamily Artubinia RHUMBLER, 1913, p. 352 [*nom. van. pro* subfamily Tubinellinae Rhumbler, 1906].

Early milioline stage reduced; later portion uniserial with rudimentary septa; aperture formed by the open end of the final chamber.

Family SORITIDAE Ehrenberg, 1839

Family Soritidae GALLOWAY, 1933, p. 132 [*nom. correct. pro* family Soritina Ehrenberg, 1839].

Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].

Family Helicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].

Family Enthomostègues D'ORBIGNY, 1826, p. 304 (*partim*) [*nom. nud; nom. neg.*].

Family Soritina EHRENBERG, 1839, table opposite p. 120.

Family Helicosorina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Family Asterodiscina EHRENBERG, 1839, table opposite p. 120 (*partim*).

Family Orbitolitidae GRAY, 1840, *fide* Agassiz, 1844, p. 19 (cited in error as Gray, 1804).

Family Myrioporina AGASSIZ, 1844, p. 16 [*nom. nud.*].

Family Soritida SCHULTZE, 1854, p. 53 [*nom. correct. pro* family Soritina Ehrenberg, 1839].

Family Nautiloida SCHULTZE, 1854, p. 53 (*partim*) [*nom. correct. pro* family Nautiloidae d'Orbigny, 1839, *nom. nud.*].

Family Helicostegia REUSS, 1860, p. 151, 205 (*partim*) [*nom. nud.*].

Family Peneroplidae REUSS, 1860, p. 151 [*nom. transl. ex* subfamily Peneroplida Schultze, 1854].

Family Cristellaridae REUSS, 1860, p. 151, 205 [*nom. transl. ex* subfamily Cristellarida Schultze, 1854].

Family Cristellaridea REUSS, 1862, p. 307, 335, 368 [*nom. correct. pro* family Cristellaridae Reuss, 1860].

Family Peneroplideae REUSS, 1860, p. 217 [*nom. correct. pro* family Peneroplidae Reuss, 1860].

Family Peneroplidea REUSS, 1862, p. 379 [*nom. correct. pro* family Peneroplidae Reuss, 1860].

Family Orbitulitidea REUSS, 1862, p. 376.

Family Orbitulitideae GÜMBEL, 1868, p. 27 [*nom. correct. pro* family Orbitulitidea Reuss, 1862].

Family Cristellarideae GÜMBEL, 1868, p. 54 [*nom. correct. pro* family Cristellaridae Reuss, 1860].

Family Orbiculinida JONES *in* Griffith & Henfrey, 1875, p. 319.

Family Peneroplida JONES *in* Griffith & Henfrey, 1875, p. 319 [*nom. correct. pro* family Peneroplidae Reuss, 1860].

Family Cristellaroidi SCHWAGER, 1876, p. 477 [*nom. correct. pro* family Cristellaridae Reuss, 1860].

Family Peneroplidee SCHWAGER, 1876, p. 483 [*nom. correct. pro* family Peneroplidae Reuss, 1860].

Family Orbitulitidee SCHWAGER, 1876, p. 483 [*nom. correct. pro* family Orbitulinidea Reuss, 1862].

Family Cristellarioidea SCHWAGER, 1877, p. 19 [*nom. correct. pro* family Cristellaridae Reuss, 1860].

Family Orbitulita MARRIOTT, 1878, p. 31 [*nom. correct. pro* family Orbitulitidea Reuss, 1862].

Family Peneroplidina BÜTSCHLI *in* Bronn, 1880, p. 190 [*nom. correct. pro* family Peneroplidae Reuss, 1860].

Family Orbitolitina BÜTSCHLI *in* Bronn, 1880, p. 192.

Family Keramosphaerina LANKESTER, 1885, p. 847 [*nom. transl. ex* subfamily Keramosphaerinae Brady, 1884].

Family Peneroplinae DELAGE & HÉROUARD, 1896, p. 124 [*nom. correct. pro* family Peneroplidae Reuss, 1860].

Family Keramosphaerinae DELAGE & HÉROUARD, 1896, p. 127 [*nom. correct. pro* family Keramosphaerina Lankester, 1885].

Familie des Orbitolites DOUVILLÉ, 1902, p. 290 [*nom. neg.*].

Familie des Orbiculines DOUVILLÉ, 1902, p. 297 [*nom. neg.*].

Family Peneroplididae LISTER *in* Lankester, 1903, p. 143 [*nom. correct. pro* family Peneroplidae Reuss, 1860].

Family Keramosphaeridae LISTER *in* Lankester, 1903, p. 143 [*nom. correct. pro* family Keramosphaerina Lankester, 1885].

Family Cristellariidae WEDEKIND, 1937, p. 98 [*nom. correct. pro* family Cristellaridae Reuss, 1860].

Family Meandropsinidae HENSON, 1948, p. 77.

Wall calcareous, porcellanous, may be pitted or perforated in early stage; chambers planispiral, later serial, flabelliform or cyclical; interior simple or labyrinthic; aperture single and simple or dendritic, or multiple.

Subfamily PENEROPLINAE Schultze, 1854

Subfamily Peneroplinae CUSHMAN *in* Eastman, 1913, p. 39 [*nom. correct. pro* subfamily Peneroplida Schultze, 1854].

Subfamily Peneroplida SCHULTZE, 1854, p. 53.

Subfamily Cristellarida SCHULTZE, 1854, p. 53.

Subfamily Peneroplidinae BRADY, 1884, p. 62 [*nom. correct. pro* subfamily Peneroplida Schultze, 1854].

Subfamily Cristellarinae RHUMBLER, 1895b, p. 91 [*nom. correct. pro* subfamily Cristellarida Schultze, 1854].

Subfamily Spirolininae CUSHMAN, 1927, p. 54.

Test close coiled in early stage, later may be uncoiled or annular; chambers simple, not divided into chamberlets; aperture rounded, slitlike or a series of pores on the final septal face.

Subfamily MEANDROPSININAE Henson, 1948

Subfamily Meandropsininae SIGAL *in* Piveteau, 1952, p. 202 [*nom. transl. ex* family Meandropsinidae Henson, 1948].

Subfamily Broekininae MARIE, 1958, p. 128.

Early stage planispirally coiled, later may be discoidal, operculiform, flabelliform, cylindrical or conical in shape; subepidermal chamberlets in the marginal zone, with interseptal pillars; aperture commonly cribrate.

Subfamily RHAPYDIONININAE Keijzer, 1945

Subfamily Rhapydionininae KEIJZER, 1945, p. 200.

Test elongate, conical; chambers in rectilinear series, subdivided into chamberlets; aperture terminal, cribrate.

Subfamily ARCHAIASINAE Cushman, 1927

Subfamily Archaiasinae CUSHMAN, 1927, p. 55.

Subfamily Orbiculininae SCHUBERT, 1920, p. 168 [*nom. transl. ex* family Orbiculinida Jones, 1875].

Subfamily Archaiadinae WIESNER, 1931, p. 60, 74, 111 [*nom. correct. pro* subfamily Archaiasinae Cushman, 1927].

Test planispiral, later may become annular; chambers divided into rectangular chamberlets which do not alternate regularly with those of adjacent chambers; aperture commonly a double row of pores on the peripheral face of the last chamber.

Subfamily SORITINAE Ehrenberg, 1839

Subfamily Soritinae WIESNER, 1931, p. 60, 74, 111 [*nom. transl. ex* family Soritina Ehrenberg, 1839].

Subfamily Orbitulinidea REUSS, 1862, p. 320.

Subfamily Orbitolitinae BRADY, 1881, p. 43.

Growth occurs by addition of numerous small chambers in arcuate or annular series, without intercommunication between those of a single series, apertures connect adjacent chambers of successive series.

Subfamily KERAMOSPHAERINAE Brady, 1884

Subfamily Keramosphaerinae BRADY, 1884, p. 63.

Test globular, concentric chambers subdivided into chamberlets; pores between chambers of same series and between those of successive series.

Family ALVEOLINELLIDAE Cushman, 1927

Family Alveolinellidae CUSHMAN, 1927, p. 58.

Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].

Family Enthomostègues D'ORBIGNY, 1826, p. 304 (*partim*) [*nom. nud.; nom. neg.*].

Family Alveolinea EHRENBERG, 1839, table opposite p. 120.

Family Alveolinida SCHULTZE, 1854, p. 53 [*nom. correct. pro* family Alveolinea Ehrenberg, 1839].

Family Alveolinidae STEINMANN, 1881, p. 41 [*nom. correct. pro* family Alveolinea Ehrenberg, 1839].

Subfamily Alveolininae BRADY, 1884, p. 62 [*nom. transl. ex* family Alveolinea Ehrenberg, 1839].

Family Alveolinina LANKESTER, 1885, p. 847 [*nom. correct. pro* family Alveolinea Ehrenberg, 1839].

Family Alveolininae DELAGE & HÉROUARD, 1896, p. 127 [*nom. correct. pro* family Alveolinea Ehrenberg, 1839].

Subfamily Borelidinae WIESNER, 1931, p. 60, 75 [*nom. subst. pro* subfamily Alveolininae Brady, 1884].

Family Borelidae HANZAWA, 1932, p. 36, 102 [*nom. subst. pro* family Alveolinidae Steinmann, 1881].

Subfamily Alveolinellinae GALLOWAY, 1933, p. 148 [*nom. transl. ex* family Alveolinellidae Cushman, 1927].

Family Fasciolitidae HENRICI, 1934, p. 36.

Test free, large fusiform to subspherical; proloculus followed by spiral passage, irregularly coiled to planispiral; secondary septa occur in direction of coiling to form chamberlets; apertures are pores which correspond in position to that of the chamberlets.

Remarks.—The genus *Alveolina* d'Orbigny, 1826, is a junior synonym of *Borelis* Montfort, 1808; hence the family and subfamily names Borelidae Hanzawa, 1932 and Borelidinae Wiesner, 1931 were proposed to replace those based on *Alveolina*. However, the Alveolinellidae Cushman, 1927, has priority over these.

Superfamily NODOSARIACEA Ehrenberg, 1839, *nom. correct.*

Superfamily Nodosariacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Nodosariidea Nørvang, 1957].

Tribu Nantilites LATREILLE, 1825, p. 165 (*partim*).

Tribu Orthocerata LATREILLE, 1825, p. 162 (*partim*).

Tribu Polycyclica LATREILLE, 1825, p. 164 (*partim*).

Suborder Monosomatia EHRENBERG, 1839, table opposite p. 120 (*partim*).

Order Stichostègues D'ORBIGNY *in* de la

Sagra, 1839, p. xxxvii, 5 (*partim*) [*nom. neg.*].

Order Enallostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 125 (*partim*) [*nom. neg.*].

Order Helicostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 27 (*partim*) [*nom. neg.*].

Group Helicoidea SCHULTZE, 1854, p. 53 (*partim*).

Group Rhabdoidea SCHULTZE, 1854, p. 53.

Helicostegia REUSS, 1860, p. 151, 205 (*partim*).

Nautiloidea REUSS, 1860, p. 151 (*partim*) [*nom. transl. ex* family Nautiloidae d'Orbigny, 1839].

Stichostegia REUSS, 1860, p. 151, 178 (*partim*).

Suborder Perforata CARPENTER, PARKER & JONES, 1862, p. 149 (*partim*).

Foraminifera Monomera REUSS, 1862, p. 362 (*partim*).

Foraminifera Polymera REUSS, 1862, p. 365 (*partim*).

Tribus Perforata CLAUS, 1872, p. 108 (*partim*) [*nom. transl. ex* suborder Perforata Carpenter, Parker & Jones, 1862].

Group Lagenidae BÜTSCHLI *in* Bronn, 1880, p. 196.

Subclass Perforata LANKESTER, 1885, p. 847 (*partim*).

Order Lagenidea LANKESTER, 1885, p. 847.

Perforata (Foraminifera) HAECKEL, 1894, p. 164 (*partim*).

Order Perforida DELAGE & HÉROUARD, 1896, p. 135 (*partim*).

Suborder Lagenidae DELAGE & HÉROUARD, 1896, p. 136 [*nom. transl. ex* family Lagenidea Reuss, 1862].

Titanostichostegia EIMER & FICKERT, 1899, p. 676.

Superfamily Enclinostegia EIMER & FICKERT, 1899, p. 682 (*partim*) [*nom. nud.*].

Suborder Perforina CALKINS, 1901, p. 108 (*partim*) [*nom. correct. pro* suborder Perforata Carpenter, Parker & Jones, 1862].

Order Lagenaceae HARTOG *in* Harmer & Shipley, 1906, p. 59 [*nom. correct. pro* order Lagenidea Lister, 1903].

Order Lagenida CALKINS, 1909, p. 39 [*nom. correct. pro* order Lagenidea Lister, 1903].

Telostoma SCHUBERT, 1920, p. 172.

Family group Nodosalidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 86 (*partim*).

Order Nodosalidia CALKINS, 1926, p. 355 (*partim*).

Order Nodosaridia KÜHN, 1926, p. 134 (*partim*).

Order Orthostili (Perforata) SILVESTRI, 1937, p. 89 (*partim*).

Order Nodosarioidea WEDEKIND, 1937, p. 86.

Suborder Cristellariacea WEDEKIND, 1937, p. 93 (*partim*).

Suborder Lenticulinacea WEDEKIND, 1937, p. 99.

Suborder Polymorphinacea WEDEKIND, 1937, p. 103.

Suborder Robulinacea WEDEKIND, 1937, p. 104.

Superfamily Lagenidea GLAESSNER, 1945, p. 126 [*nom. transl. ex* family Lagenidea Reuss, 1862].

Suborder Pluriloculinidea SIGAL *in* Piveteau 1952, p. 160 (*partim*).

Superfamily Nodosariidea NØRVANG, 1957, p. 23 [*nom. transl. ex* family Nodosarina Ehrenberg, 1839].

Superfamily Lagenicae EASTON, 1960, p. 65, 78 [*nom. correct. pro* superfamily Lagenidea Glaessner, 1945].

Wall of finely perforate, radial laminated calcite; chambers planispirally coiled or uncoiled, or straight, or coiled about a longitudinal axis; aperture peripheral or terminal, typically radiate, or may be slit-like or rounded.

Family NODOSARIIDAE Ehrenberg, 1839

Family Nodosariidae LISTER *in* Lankester, 1903, p. 144 [*nom. correct. pro* family Nodosarina Ehrenberg, 1839].

Family Polystoma LATREILLE, 1825, p. 161 (*partim*) [*nom nud.*].

Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].

Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].

Family Stichostègues D'ORBIGNY, 1826, p. 251 (*partim*) [*nom. nud.; nom. neg.*].

Family Nodosarina EHRENBERG, 1839, table opposite p. 120.

Family Equilateralidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxvii, 11 (*partim*) [*nom. nud.*].

Family Nautiloidae D'ORBIGNY *in* de la

Sagra, 1839, p. xxxviii, 38 (*partim*) [*nom. nud.*].

Family Rhizopodes DUJARDIN, 1841, p. 126, 240 (*partim*) [*nom. nud.; nom. neg.*].

Family Aequilateralidae D'ORBIGNY, 1846, p. 28 (*partim*) [*nom. correct pro* family Equilateralidae d'Orbigny, 1839; *nom. nud.*].

Family Nodosarida SCHULTZE, 1854, p. 53 [*nom. correct. pro* family Nodosarina Ehrenberg, 1839].

Family Nautiloida SCHULTZE, 1854, p. 53 (*partim*) [*nom. correct. pro* family Nautiloidae d'Orbigny, 1839, *nom. nud.*].

Family Nodosaridae REUSS, 1860, p. 151, 178 [*nom. correct. pro* family Nodosarina Ehrenberg, 1839].

Family Nautiloidea REUSS, 1860, p. 151 [*nom. correct. pro* family Nautiloidae d'Orbigny, 1839, *nom. nud.*].

Family Stichostegia REUSS, 1860, p. 151, 178 (*partim*) [*nom. nud.*].

Family Frondicularidae REUSS, 1860, p. 151, 191.

Family Vaginulinidae REUSS, 1860, p. 151.

Family Lagenidea REUSS, 1862, p. 305.

Family Rhabdoidea REUSS, 1862, p. 365 (*partim*) [*nom. nud.*].

Family Lagenida CARPENTER, PARKER & JONES, 1862, p. 154 [*nom. correct. pro* family Lagenidea Reuss, 1862].

Family Lagenideae GÜMBEL, 1868, p. 28 [*nom. correct. pro* family Lagenidea Reuss, 1862].

Family Nodosarideae GÜMBEL, 1868, p. 30 [*nom. correct. pro* family Nodosarina Ehrenberg, 1839].

Family Frondicularideae GÜMBEL, 1868, p. 53 [*nom. correct. pro* family Frondicularidae Reuss, 1860].

Family Vaginulinideae GÜMBEL, 1868, p. 53 [*nom. correct. pro* family Vaginulinidae Reuss, 1860].

Family Lagene SCHWAGER, 1876, p. 476 [*nom. correct. pro* family Lagenidea Reuss, 1862].

Family Nodosarie SCHWAGER, 1876, p. 476 [*nom. correct. pro* family Nodosarina Ehrenberg, 1839].

Family Dentalinoidea SCHWAGER, 1877, p. 18.

Family Lagenoidea SCHWAGER, 1877, p. 18 [*nom. correct. pro* family Lagenidea Reuss, 1862].

Family Lagenidae SCHULZE, 1877, p. 29 [*nom. correct. pro* family Lagenidea Reuss, 1862].

Family Rhabdoina BÜTSCHLI *in* Bronn, 1880, p. 197 (*partim*) [*nom. nud.*].

Family Lagenina LANKESTER, 1885, p. 847 [*nom. correct. pro* family Lagenidea Reuss, 1862].

Family Lagenetta HAECKEL, 1894, p. 164 [*nom. correct. pro* family Lagenidea Reuss, 1862].

Family Nodosaretta HAECKEL, 1894, p. 164 [*nom. correct. pro* family Nodosarina Ehrenberg, 1839].

Family Lageninae DELAGE & HÉROUARD, 1896, p. 137 [*nom. correct. pro* family Lagenidea Reuss, 1862].

Family Nodosarinae DELAGE & HÉROUARD, 1896, p. 137 [*nom. correct. pro* family Nodosarina Ehrenberg, 1839].

Family Arnodosaridia RHUMBLER, 1913, p. 342 [*nom. van. pro* family Nodosarina Ehrenberg, 1839].

Family Lenticulinidae CHAPMAN, PARR & COLLINS, 1934, p. 554.

Family Robulinidae WEDEKIND, 1937, p. 104 [*nom. transl. ex* subfamily Robulinae Galloway, 1933].

Family Nodosariellidae WEDEKIND, 1937, p. 93.

Family Marginulinellidae WEDEKIND, 1937, p. 94.

Family Marginulinidae WEDEKIND, 1937, p. 99.

Family Hydromylinidae DE WITT PUYT, 1941, p. 54.

Test free, one or more chambers in planispiral, uncoiling, curved or straight series; aperture simple or radiate, peripheral in coiled forms, terminal in straight forms, may have apertural chamberlet, or may have elongate neck.

Subfamily LAGENINAE Reuss, 1862

Subfamily Lageninae BRADY, 1881, p. 44 [*nom. transl. ex* family Lagenidea Reuss, 1862].

Test consisting of a single chamber; aperture terminal, rounded or radiate.

Subfamily NODOSARIINAE Ehrenberg, 1839

Subfamily Nodosariinae CHAPMAN, 1900b,

p. 30 [*nom. correct. pro* subfamily Nodosaridea Reuss, 1862].

Subfamily Nodosaridea Reuss, 1862, p. 334 [*nom. transl. ex* family Nodosarina Ehrenberg, 1839].

Subfamily Vaginulinidea Reuss, 1862, p. 366 [*nom. transl. ex* family Vaginulinidae Reuss, 1860].

Subfamily Frondicularidea Reuss, 1862, p. 307, 335, 366, 395 [*nom. transl. ex* family Frondicularidae Reuss, 1860].

Subfamily Dentalinidae Schwager, 1877, p. 18.

Subfamily Nodosarinae Brady, 1884, p. 69 [*nom. transl. ex* family Nodosarina Ehrenberg, 1839].

Subfamily Glandulonodosariinae Silvestri, 1901, p. 109.

Subfamily Frondicullariinae Galloway, 1933, p. 235 [*nom. correct. pro* subfamily Frondicularidea Reuss, 1862].

Subfamily Robulinae Galloway, 1933, p. 250.

Subfamily Lenticulininae Chapman, Parr & Collins, 1934, p. 554.

Subfamily Marginulinae Nørvang, 1957, p. 83 [*nom. transl.* and *nom. imperf. ex* family Marginulinidae Wedekind, 1937].

Subfamily Lenticulinae Nørvang, 1957, p. 93 [*nom. van. pro* subfamily Lenticulininae Chapman, Parr & Collins, 1934].

Test multilocular, chambers arranged in straight, arcuate or enrolled series; aperture terminal, rounded or radiate.

Subfamily Lingulininae Loeblich & Tappan, *subfam. nov.*

Test multilocular, chambers arranged in straight or arcuate series; aperture terminal, a single elongate slit. Type genus: *Lingulina* d'Orbigny, 1826.

Family Polymorphinidae d'Orbigny, 1839

Family Polymorphinidae d'Orbigny *in* de la Sagra, 1839, p. xxxix, 131.

Family Énallostègues d'Orbigny, 1826, p. 260 (*partim*) [*nom. nud.; nom. neg.*].

Family Turbinoidae d'Orbigny *in* de la Sagra, 1839, p. xxxviii, 71 [*nom. nud.*].

Family Uvellina Ehrenberg, 1839, table opposite p. 120 [*nom. nud.*].

Family Polymorphinidées d'Orbigny, 1840, p. 9 [*nom. neg.*].

Family Polymorphinideae Reuss, 1860, p. 230 [*nom. correct. pro* family Polymorphinidae d'Orbigny, 1839].

Family Polymorphinidea Reuss, 1860, p 151 [*nom. correct. pro* family Polymorphinidae d'Orbigny, 1839].

Family Polymorphinida Jones *in* Griffith & Henfrey, 1875, p. 320 [*nom. correct. pro* family Polymorphinidae d'Orbigny, 1839].

Family Polymorphinidee Schwager, 1876, p. 479 [*nom. correct. pro* family Polymorphinidae d'Orbigny, 1839].

Family Polymorphinina Bütschli *in* Bronn, 1880, p. 200 [*nom. correct. pro* family Polymorphinidae d'Orbigny, 1839].

Family Ramulinina Lankester, 1885, p. 847 [*nom. transl. ex* subfamily Ramulininae Brady, 1884].

Family Polymorphinae Delage & Hérouard, 1896, p. 138 [*nom. correct. pro* family Polymorphinidae d'Orbigny, 1839].

Family Ramulinae Delage & Hérouard, 1896, p. 138 [*nom. correct. pro* family Ramulinina Lankester, 1885].

Family Ramulinidae Lister *in* Lankester, 1903, p. 145 [*nom. correct. pro* family Ramulinina Lankester, 1885.]

Family Enantiomorphinidae Marie, 1941, p. 142.

Test multilocular, chambers in a spiral or sigmoidal coil about a longitudinal axis of growth, or biserial or uniserial, typically somewhat overlapping; abberrant forms may be irregular and attached; apertures all develop in same direction, terminal, radiate.

Subfamily Polymorphininae d'Orbigny, 1839

Subfamily Polymorphininae Brady, 1881, p. 44 [*nom. transl. ex* family Polymorphinidae d'Orbigny, 1839].

Test free, chambers arranged in spiral, sigmoidal or biserial series.

Subfamily Enantiomorphininae Marie, 1941, *nom. transl.*

Subfamily Enantiomorphininae Loeblich & Tappan, herein [*nom. transl. ex* family Enantiomorphinidae Marie, 1941].

Test elongate, chambers alternating in an asymmetrical series; aperture terminal, radiate.

Subfamily WEBBINELLINAE Rhumbler, 1904, emended

Subfamily Webbinellinae RHUMBLER, 1904, p. 224.

Subfamily Arwebbina RHUMBLER, 1913, p. 346 [*nom. van. pro* subfamily Webbinellinae Rhumbler, 1904].

Test attached, one or more chambers connected by stolons, early portion may be globular or polymorphine, with attachment rounded or irregularly spreading.

Remarks.—The subfamily was originally defined for the agglutinated attached single chambered forms herein included in the Hemisphaeramminae, *subfam. nov.* However, the type specimen of the type species of *Webbinella* Rhumbler, 1903 is an attached polymorphinid; hence the generic and family names based on it are here transferred.

Subfamily RAMULININAE Brady, 1884

Subfamily Ramulininae BRADY, 1884, p. 71.

Test free, with one or more chambers connected by stolons.

Family GLANDULINIDAE Reuss, 1860

Family Glandulinidae REUSS, 1860, p. 151.

Family Stichostègues D'ORBIGNY, 1826, p. 251 (*partim*) [*nom. nud.; nom. neg.*].

Test unilocular or with chambers in biserial, uniserial or polymorphine arrangement; aperture terminal, radial or slitlike, with a simple, straight or curved internal (entosolelian) tube.

Subfamily GLANDULININAE Reuss, 1860, *nom. correct.*

Subfamily Glandulininae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Glandulinidea Reuss, 1862].

Subfamily Glandulinidea REUSS, 1862, p. 307 [*nom. transl. ex* family Glandulinidae Reuss, 1860].

Subfamily Glandulinea HANTKEN, 1875, p. 41 [*nom. correct. pro* subfamily Glandulinidea Reuss, 1862].

Test biserial, uniserial or polymorphine; aperture terminal, radial or slitlike, with internal tube.

Subfamily SEABROOKIINAE Cushman, 1927

Subfamily Seabrookiinae CUSHMAN, 1927, p. 86.

Test compressed, early stage with proloculus and two chambers per whorl, later chambers added 180° from the preceding and completely enveloping earlier formed chambers; aperture terminal, oval to slitlike, commonly with thickened lip.

Subfamily OOLININAE Loeblich & Tappan, *subfam. nov.*

Test unilocular, with slitlike or radiate aperture and entosolenian tube: Type genus: *Oolina* d'Orbigny, 1839.

Superfamily BULIMINACEA Jones, 1875, *nom. correct.*

Superfamily Buliminacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Buliminidea Glaessner, 1945 and Buliminicae Easton, 1960].

Order Hélicostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 27 (*partim*) [*nom. neg.*].

Helicostegia REUSS, 1860, p. 151, 205 (*partim*).

Turbinoidea REUSS, 1860, p. 151 (*partim*).

Superfamily Enclinostegia EIMER & FICKERT, 1899, p. 682 (*partim*) [*nom. nud.*].

Suborder Perforina CALKINS, 1901, p. 108 (*partim*).

Schizostoma SCHUBERT, 1920, p. 179 (*partim*).

Family group Texulinidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88 (*partim*) [*nom. transl. ex* family Texulinidae Rhumbler, 1913].

Order Textulinida CALKINS, 1926, p. 356 (*partim*).

Order Orthostili (Perforata) SILVESTRI, 1937, p. 89 (*partim*).

Superfamily Buliminidea GLAESSNER, 1945, p. 134 [*nom. transl. ex* family Buliminida Jones, 1875].

Order Dentata HOFKER, 1951, p. 14 (*partim*).

Suborder Protoforaminata HOFKER, 1951, p. 42 (*partim*).

Suborder Pluriloculinidea SIGAL *in* Piveteau, 1952, p. 160 (*partim*).

Order Buliminida FURSENKO, 1958, p. 24 [*nom. transl. ex* family Buliminida Jones, 1875].

Superfamily Buliminicae EASTON, 1960, p. 65, 79 [*nom. correct. pro* superfamily Buliminidea Glaessner, 1945].

Test a high trochospiral, or modified to biserial or uniserial; wall finely or coarsely perforate, of radially built calcite; aperture primary, a basal slit, or in the apertural face or terminal; may have internal toothplate or tube, and aperture may be on a neck.

Family TURRILINIDAE Cushman, 1927, *nom. transl.*

Family Turrilinidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Turrilininae Cushman, 1927].

Family Buliminellidae HOFKER, 1951, p.121.

Test a high trochospiral, with more than three chambers per whorl, or may be reduced to biserial; wall of radially lamellar calcite; apertural face poreless, formed by outgrowth from toothplate, may be radially grooved.

Subfamily LACOSTEININAE Sigal, 1952

Subfamily Lacosteininae SIGAL *in* Piveteau, 1952, p. 220.

Early portion planispirally coiled, later changing abruptly to elongate growth axis with three or four chambers per whorl; aperture loop-shaped, in the face of the final chamber.

Subfamily TURRILININAE Cushman, 1927

Subfamily Turrilininae CUSHMAN, 1927, p. 65.

Subfamily Buliminellinae BYKOVA *in* Rauser-Chernousova & Fursenko, 1959, p. 323 [*nom. transl. ex* family Buliminellidae Hofker, 1951].

Test elongate, closely spiralling, with three or more chambers per whorl; aperture loop-shaped, in the face of the last-formed chamber.

Family SPHAEROIDINIDAE Cushman, 1927, *nom. transl.*

Family Sphaeroidinidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Sphaeroidininae Cushman, 1927].

Family Uvellina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Subfamily Sphaeroidininae CUSHMAN, 1927, p. 86.

Early portion trochospiral, later streptospiral, with chambers embracing most of the preceding ones; aperture interiomarginal, with a rounded tooth.

Family BOLIVINITIDAE Cushman, 1927

Family Bolivinitidae GLAESSNER, 1936, p. 127 [*nom. transl. ex* subfamily Bolivinitinae Cushman, 1927].

Family Bolivinidae HOFKER, 1951, p. 48 [*nom. transl. ex* subfamily Bolivininae Glaessner, 1937].

Family Silicotextulinidae SIGAL *in* Piveteau, 1952, p. 163.

Family Plectofrondicullariidae MONTANARO GALLITELLI, 1957, p. 143.

Test biserial, at least in the young stage; aperture comma-shaped, basal or terminal.

Subfamily BOLIVININAE Glaessner, 1937

Subfamily Bolivininae GLAESSNER, 1937b, p. 420.

Test biserial throughout; aperture interiomarginal, parallel to the compression of the test.

Subfamily BOLIVINITINAE Cushman, 1927

Subfamily Bolivinitinae CUSHMAN, 1927, p. 61.

Test biserial throughout, quadrate or rhomboidal in section; aperture interiomarginal, parallel to compression of test, commonly with an external lip, and provided internally with a columellar toothplate.

Subfamily PLECTOFRONDICULARIINAE Cushman, 1927

Subfamily Plectofrondicullariinae CUSHMAN, 1927, p. 62.

Test biserial to uniserial; aperture terminal, dentate or cribrate.

Family EOUVIGERINIDAE Cushman, 1927, *nom. transl.*

Family Eouvigerinidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Eouvigerininae Cushman, 1927].

Subfamily Eouvigerininae CUSHMAN, 1927, p. 63.

Test biserial in the young, later may become uniserial; aperture terminal, with internal siphon, and may have everted phialine lip.

Family BULIMINIDAE Jones, 1875

Family Buliminidae EIMER & FICKERT, 1899, p. 680 [*nom. correct. pro* family Buliminida Jones, 1875].

Family Stichostègues D'ORBIGNY, 1826, p. 251 (*partim*) [*nom. nud.; nom. neg.*].

Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].

Family Uvellina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Family Helicosorina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Family Equilateralidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxvii, 11 (*partim*) [*nom. nud.*].

Family Turbinoidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 (*partim*) [*nom. nud.*].

Family Aequilateralidae D'ORBIGNY, 1846, p. 28 (*partim*) [*nom. correct. pro* family Equilateralidae d'Orbigny, 1839; *nom. nud.*].

Family Uvellidae REUSS, 1860, p. 225 (*partim*) [*nom. nud.*].

Family Buliminida JONES *in* Griffith & Henfrey, 1875, p. 320.

Family Buliminidee SCHWAGER, 1876, p. 479 [*nom. correct. pro* family Buliminida Jones, 1875].

Family Buliminidea SCHWAGER, 1877, p. 19 [*nom. correct. pro* family Buliminida Jones, 1875].

Family Buliminina LANKESTER, 1885, p. 847 [*nom. correct. pro* family Buliminida Jones, 1875].

Family Buliminae DELAGE & HÉROUARD, 1896, p. 140 [*nom. correct. pro* family Buliminida Jones, 1875].

Family Pavoninidae EIMER & FICKERT, 1899, p. 678.

Family Globobuliminidae HOFKER, 1956a, p. 908 [*nom. transl. ex* subfamily Globobulimininae Hofker, 1951].

Family Hyalovirgulinidae HOFKER, 1956b, p. 45 [*nom. nud.*].

Test a high trochospiral, with not over three chambers per whorl, may reduce to biserial; aperture a loop in the apertural face, with platelike internal tooth connecting successive chambers, or aperture may be indistinct and represented only by pores in the terminal chamber face.

Subfamily BULIMININAE Jones, 1875

Subfamily Bulimininae BRADY, 1881, p. 44 [*nom. correct. pro* subfamily Buliminidae Schwager, 1877].

Subfamily Buliminidae SCHWAGER, 1877, p. 19 [*nom. transl. ex* family Buliminida Jones, 1875].

Subfamily Buliminae RHUMBLER, 1895b, p. 89 [*nom. correct. pro* subfamily Buliminidae Schwager, 1877].

Subfamily Globobulimininae HOFKER, 1951, p. 248.

Test triserial throughout; aperture loop-shaped, with a distinctive toothplate.

Subfamily PAVONININAE Eimer & Fickert, 1899

Subfamily Pavonininae CUSHMAN, 1927, p. 59 [*nom. transl. ex* family Pavoninidae Eimer & Fickert, 1899].

Subfamily Reussiinae CUSHMAN, 1927, p. 68 (*pro Reussia* Schwager, 1877; not *Reussia* McCoy, 1854).

Subfamily Reussellinae CUSHMAN, 1933, p. 223 [*nom. subst. pro* subfamily Reussiinae Cushman, 1927].

Test triserial in early stage, rarely biserial, later uniserial; aperture loop-shaped or represented by pores on the terminal chamber face.

Family UVIGERINIDAE Cushman, 1913

Family Uvigerinidae GALLOWAY & WISSLER 1927, p. 74 [*nom. transl. ex* subfamily Uvigerininae Cushman, 1913].

Family Uvellina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Family Turbinoidea D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 (*partim*) [*nom. nud.*].

Subfamily Uvigerininae CUSHMAN, 1913, p. 91.

Subfamily Angulogerininae GALLOWAY, 1933, p. 377.

Family Uvigerinida COPELAND, 1956, p. 188 [*nom. van. pro* family Uvigerinidae Galloway & Wissler, 1927].

Test triserial in the early stage, later may become biserial or uniserial; aperture terminal, with a neck and with an internal toothplate connecting the apertures of successive chambers.

Superfamily ASTERIGERINACEA d'Orbigny, 1839, *nom. transl.*

Superfamily Asterigerinacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Asterigerinidae d'Orbigny, 1839].

Tribu Nantilites LATREILLE, 1825, p. 165 (*partim*).

Tribu Polycyclica LATREILLE, 1825, p. 164 (*partim*).

Order Hélicostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 27 (*partim*) [*nom. neg.*].

Group Soroidea SCHULTZE, 1854, p. 53.

Helicostegia REUSS, 1860, p. 151, 205 (*partim*).

Turbinoidea REUSS, 1860, p. 151 (*partim*).

Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 685 (*partim*) [*nom. nud.*].

Suborder Perforina CALKINS, 1901, p. 108 (*partim*).

Family group Rotaliaridia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88 (*partim*).

Order Dentata HOFKER, 1951, p. 14 (*partim*)

Suborder Biforaminata HOFKER, 1951, p. 306 (*partim*).

Suborder Deuteroforaminata HOFKER, 1951, p. 412 (*partim*).

Superfamily Discorbidea SMOUT, 1954, p. 81 [*nom. transl. ex* subfamily Discorbininae Schubert, 1920].

Superfamily Monolamellidea REISS, 1957, p. 128 [*nom. nud.*].

Test trochospiral, or derived from such; wall of radial laminated calcite, perforate, non-canaliculate, single walls and septa; aperture interiomarginal or areal, or derived from such.

Family DISCORBIDAE Cushman, 1927

Family Discorbidae GLAESSNER, 1945, p. 145 [*nom. transl. ex* subfamily Discorbisinae Cushman, 1927].

Family Polystoma LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].

Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].

Family Uvellina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Family Turbinoidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 (*partim*) [*nom. nud.*].

Family Cyclospiridae EIMER & FICKERT, 1899, p. 702 [*nom. nud.*, based on *Cyclospira* Eimer & Fickert, 1899, not *Cyclospira* Hall & Clarke, 1894, Brachiopoda].

Family Valvulineriidae BROTZEN, 1942, p. 16.

Family Laticarinidae HOFKER, 1951, p. 307 [*nom. imperf.*].

Family Eponidae HOFKER, 1951, p. 321 [*nom. imperf.*]

Family Conorbidae HOFKER, 1951, p. 414 (*pro Conorbis* Hofker, 1951; *non Conorbis* Swainson, 1840).

Family Pulvinulinidae HOFKER, 1951, p. 448 [*nom. transl. ex* subfamily Pulvinulininae Schubert, 1920].

Family Valvulineridae HOFKER, 1951, p. 484 [*nom. van. pro* family Valvulineriidae Brotzen, 1942].

Family Marginolamellidae HOFKER, 1951, p. 485 (*partim*) [*nom. nud.*].

Family Conorboididae THALMANN, 1952, p. 984 [*nom. subst. pro* family Conorbidae Hofker, 1951].

Family Eponididae THALMANN, 1952, p. 984 [*nom. correct. pro* family Eponidae Hofker, 1951].

Family Discorbididae POKORNÝ, 1954, p. 215 [*nom. van. pro* family Discorbidae Glaessner, 1945].

Test free, trochospiral; chambers simple; aperture basal or areal.

Subfamily DISCORBINAE Cushman, 1927

Subfamily Discorbinae GALLOWAY, 1933, p. 285 [*nom. correct. pro* subfamily Discorbisinae Cushman, 1927].

Subfamily Discorbininae SCHUBERT, 1920, p. 156.

Subfamily Discorbisinae CUSHMAN, 1927, p. 75 [*nom. subst. pro* subfamily Discorbininae Schubert, 1920].

Subfamily Discorbinellinae SIGAL *in* Piveteau, 1952, p. 228.

Subfamily Discorbidinae POKORNÝ, 1954, p. 215 [*nom. van. pro* subfamily Discorbinae Galloway, 1933].

Test free, trochospiral, low to high spired, umbilical region open; aperture basal, umbilical.

Remarks.—The subfamily Discorbininae Schubert, 1920 was based on the genus *Discorbina* Parker & Jones, 1862, a junior synonym of *Discorbis* Lamarck, 1804.

Subfamily EPONIDINAE Hofker, 1951

Subfamily Eponidinae SUBBOTINA *in* Rauser-Chernousova & Fursenko, 1959, p. 269 [*nom. transl. ex* family Eponidae Hofker, 1951].

Subfamily Pulvinulininae SCHUBERT, 1920, p. 152.

Test free, a low trochospiral or may be uncoiled, umbilicus closed; aperture basal or areal, single or multiple, and may be covered by a plate or spongy material.

Subfamily BAGGININAE Cushman, 1927

Subfamily Bagginininae CUSHMAN, 1927, p. 77.

Subfamily Praerotalininae HOFKER, 1933, p. 125 (*partim*) [*nom. nud.*].

Subfamily Cancrisinae CHAPMAN, PARR & COLLINS, 1934, p. 567.

Subfamily Valvulineriinae BROTZEN, 1942, p. 17.

Subfamily Cancrininae SIGAL *in* Piveteau, 1952, p. 228 [*nom. van. pro* subfamily Cancrisinae Chapman, Parr & Collins, 1934].

Subfamily Baggatellinae BYKOVA *in* Rauser-Chernousova & Fursenko, 1959, p. 325.

Test free, trochospiral, umbilical area closed, with clear thin imperforate area adjacent to the umbilicus; aperture basal.

Family SIPHONINIDAE Cushman, 1927

Family Siphoninidae BYKOVA, VASILENKO, VOLOSHINOVA, MIATLIUK & SUBBOTINA *in* Rauser-Chernousova & Fursenko, 1959, p. 270 [*nom. transl. ex* subfamily Siphonininae Cushman, 1927].

Subfamily Siphonininae CUSHMAN, 1927, p. 77.

Test trochospiral, or may become uncoiled or biserial, periphery commonly with fimbriate keel; aperture oval, bordered by a distinct lip, and projecting on a neck.

Family ASTERIGERINIDAE d'Orbigny, 1839

Family Asterigerinidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 116.

Family Helicotrochina AGASSIZ, 1844, p. 2 (*partim*) [*nom. nud.*].

Family Asterigerinida COPELAND, 1956, p. 187 [*nom. van. pro* family Asterigerinidae d'Orbigny, 1839].

Test free, trochospiral, with supplementary chamberlets on the umbilical side; aperture basal, surrounded by a papillate area.

Family EPISTOMARIIDAE Hofker, 1954

Family Epistomariidae HOFKER, 1954, p. 166.

Test trochospiral, supplementary chamberlets on the umbilical side; interiomarginal primary aperture, and supplementary sutural and areal apertures.

Family PLANORBULINIDAE Schwager, 1877

Family Planorbulinidae CUSHMAN, 1927, p. 95 [*nom. transl. ex* subfamily Planorbulinidae Schwager, 1877].

Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].

Family Turbinoidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 (*partim*) [*nom. nud.*].

Subfamily Planorbulinidae SCHWAGER, 1877 p. 20.

Subfamily Planorbulininae GALLOWAY, 1933 p. 297 [*nom. correct. pro* subfamily Planorbulinidae Schwager, 1877].

Test attached, early stage trochospiral, later with numerous chambers forming a discoidal, cylindrical, conical or subglobular test; aperture single or multiple, peripheral.

Family ACERVULINIDAE Schultze, 1854

Family Acervulinidae EIMER & FICKERT, 1899, p. 702 [*nom. correct. pro* family Acervulinida Schultze, 1854].

Family Acervulinida SCHULTZE, 1854, p. 53.

Subfamily Gypsininae SILVESTRI, 1905, p. 5.

Subfamily Acervulininae GALLOWAY, 1933, p. 308 [*nom. transl. ex* family Acervulinida Schultze, 1854].

Test free or attached, early spiral stage followed by spreading chambers, in one or many layers; no canal system; no aperture except for mural pores.

Superfamily ROTALIACEA Ehrenberg, 1839, *nom. correct.*

Superfamily Rotaliacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Rotalidea Glaessner, 1945].

Tribu Nantilites LATREILLE, 1825, p. 165.

Tribu Milleporita LATREILLE, 1825, p. 166.

Suborder Monosomatia EHRENBERG, 1839, table opposite p. 120 (*partim*).
Order Hélicostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 27 (*partim*) [*nom. neg.*].
Order Entomostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 113 (*partim*) [*nom. neg.*].
Group Helicoidea SCHULTZE, 1854, p. 53 (*partim*).
Turbinoidea REUSS, 1860, p. 151 (*partim*).
Helicostegia REUSS, 1860, p. 151, 205 (*partim*).
Foraminifera Polymera REUSS, 1862, p. 365 (*partim*).
Tribus Perforata CLAUS, 1872, p. 108 (*partim*).
Suborder Canaliculata MÖBIUS, 1880, p. 104.
Subclass Perforata LANKESTER, 1885, p. 847 (*partim*).
Order Rotalidea LANKESTER, 1885, p. 847.
Order Nummulinidea LANKESTER, 1885, p. 848.
Suborder Rotalidae DELAGE & HÉROUARD, 1896, p. 143.
Suborder Nummulitidae DELAGE & HÉROUARD, 1896, p. 147.
Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 685 (*partim*) [*nom. nud.*].
Suborder Perforina CALKINS, 1901, p. 108 (*partim*).
Suborder Tinoporinae CALKINS, 1901, p. 109.
Order Nummulitidea LISTER *in* Lankester, 1903, p. 146.
Order Rotaliaceae HARTOG *in* Harmer & Shipley, 1906, p. 59.
Order Nummulitaceae HARTOG *in* Harmer & Shipley, 1906, p. 59.
Order Rotalida CALKINS, 1909, p. 39.
Order Nummulitida CALKINS, 1909, p. 39.
Basistoma SCHUBERT, 1920, p. 148.
Family group Rotaliaridia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88.
Order Rotaliaridia KÜHN, 1926, p. 152 (*partim*).
Order Hellenoidea WEDEKIND, 1937, p. 79 (*partim*).
Suborder Rotaliacea WEDEKIND, 1937, p. 85, 115.
Suborder Nummulitacea WEDEKIND, 1937, p. 119.
Order Orthostili (Perforata) SILVESTRI, 1937, p. 89 (*partim*).
Family group Rotaliformes BROTZEN, 1942, p. 9 [*nom. neg.*].
Superfamily Rotalidea GLAESSNER, 1945, p. 143 [*nom. transl. ex* family Rotalina Ehrenberg, 1839].
Order Dentata HOFKER, 1951, p. 14 (*partim*).
Suborder Biforaminata HOFKER, 1951, p. 306 (*partim*).
Suborder Pluriloculinidea SIGAL *in* Piveteau, 1952, p. 160 (*partim*).
Superfamily Rotaliidea SMOUT, 1954, p. 40 [*nom. correct. pro* superfamily Rotalidea Glaessner, 1945].
Order Nummulitinidea COPELAND, 1956, p. 188.
Order Rotaliida FURSENKO, 1958, p. 23.
Superfamily Rotaliicae BRONNIMANN, 1958, p. 175 [*nom. correct. pro* superfamily Rotalidea Glaessner, 1945 and Rotaliidea Smout, 1954].

Canaliculate, double walls and septa of radial laminated calcite secondarily formed; without primary aperture or large pores, or with pores on apertural face or elsewhere, and may have interiomarginal intercameral foramina.

Family ROTALIIDAE Ehrenberg, 1839

Family Rotaliidae CHAPMAN, 1900a, p. 10 [*nom. correct. pro* family Rotalina Ehrenberg, 1839].
Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].
Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].
Family Rotalina EHRENBERG, 1839, table opposite p. 120.
Family Turbinoidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 (*partim*) [*nom. nud.*].
Family Turbinoida SCHULTZE, 1854, p. 52 (*partim*) [*nom. correct. pro* family Turbinoidae d'Orbigny, 1839, *nom. nud.*].
Family Rotalideae REUSS, 1860, p. 221 [*nom. correct. pro* family Rotalina Ehrenberg, 1839].
Family Rotalidea HANTKEN, 1875, p. 80 [*nom. correct. pro* family Rotalina Ehrenberg, 1839].
Family Rotalidee SCHWAGER, 1876, p. 479 [*nom. correct. pro* family Rotalina Ehrenberg, 1839].

Family Rotalidae BRADY, 1881, p. 44 [*nom. correct. pro* family Rotalina Ehrenberg, 1839].

Family Rotalinae DELAGE & HÉROUARD, 1896, p. 145 [*nom. correct. pro* family Rotalina Ehrenberg, 1839].

Family Rotaliaridae RHUMBLER, 1913, p. 339 [*nom. correct. pro* family Rotalina Ehrenberg, 1839].

Family Arrotalaridia RHUMBLER, 1913, p. 342 [*nom. van. pro* family Rotaliaridae Rhumbler, 1913].

Family Pegidiidae HERON-ALLEN & EARLAND, 1928, p. 283.

Family Chapmaniidae GALLOWAY, 1933, p. 316 (*pro Chapmania* Silvestri & Prever, 1904, *non Chapmania* Monticelli, 1893).

Family Chapmaninidae THALMANN, 1938, p. 207 [*nom. subst. pro* family Chapmaniidae Galloway, 1933].

Family Rotaliformes THALMANN, 1945, p. 403 [*nom. neg.*].

Family Pegidiida COPELAND, 1956, p. 188 [*nom. van. pro* family Pegidiidae Heron-Allen & Earland, 1928].

Family Chapmaniida COPELAND, 1956, p. 187 [*nom. van. pro* family Chapmaniidae Galloway, 1933].

Test trochospiral, all external openings, except perforations, on the umbilical side; with radial canals or fissures or umbilical cavities, and commonly with intraseptal and subsutural canals.

Subfamily ROTALIINAE Ehrenberg, 1839

Subfamily Rotaliinae CHAPMAN, 1900a, p. 11 [*nom. correct. pro* subfamily Rotalida Schultze, 1854].

Subfamily Rotalida SCHULTZE, 1854, p. 52 [*nom. transl. ex* family Rotalina Ehrenberg, 1839].

Subfamily Rotalinae CARPENTER, PARKER & JONES, 1862, p. 198 [*nom. correct. pro* subfamily Rotalida Schultze, 1854].

Subfamily Rotalina JONES *in* Griffith & Henfrey, 1875, p. 320 [*nom. correct. pro* subfamily Rotalida Schultze, 1854].

Subfamily Rotalidae SCHWAGER, 1877, p. 20 [*nom. correct. pro* subfamily Rotalida Schultze, 1854].

Subfamily Rotalininae HOFKER, 1933, p. 125.

Test trochospiral throughout; with radial canals or fissures and intraseptal and subsutural canals.

Subfamily CHAPMANININAE Thalmann, 1938

Subfamily Chapmanininae FRIZZELL, 1949, p. 482 [*nom. transl. ex* family Chapmaninidae Thalmann, 1938].

Test conical, early portion trochospiral, later uniserial; double walls and septa, with intraseptal spaces; septa invaginated into tubes or chamberlets; aperture consisting of the tube openings.

Subfamily PEGIDIINAE Heron-Allen & Earland, 1928

Subfamily Pegidiinae CHAPMAN & PARR, 1936, p. 144 [*nom. transl. ex* family Pegidiidae Heron-Allen & Earland, 1928].

Trochospirally derived test, with chambers few and inflated, each successive chamber opposed to or partially enveloping that preceding, early chambers resorbed during growth; aperture a series of tubes which may pierce the umbilical shell material.

Family PELLATISPIRIDAE Hanzawa, 1937

Family Pellatispiridae HANZAWA, 1937, p. 113.

Family Heterospiridae UMBGROVE, 1936, p. 156 (*pro Heterospira* Umbgrove, 1936; *non Heterospira* Koken, 1896).

Family Biplanispiridae THALMANN, 1939, p. 455 [*nom. subst. pro* family Heterospiridae Umbgrove, 1936].

Family Miscellaneidae SIGAL *in* Piveteau, 1952, p. 244.

Subfamily Pellatispirinae PURI, 1957, p. 99 [*nom. transl. ex* family Pellatispiridae Hanzawa, 1937].

Subfamily Miscellaneinae KACHARAVA *in* Rauser-Chernousova & Fursenko, 1959, p. 314 [*nom. transl. ex* family Miscellaneidae Sigal, 1952].

Test trochospiral or nearly planispiral, but spiral and umbilical sides not differentiated in structure; strongly developed canal system with subsutural and intraseptal canals and vertical canals or fissures; without differentiated marginal cord, spines or retral processes; aberrant genera may have complex spire or lateral chambers.

Family CALCARINIDAE Schwager, 1876

Family Calcarinidae EIMER & FICKERT, 1899, p. 703 [*nom. correct. pro* family Calcarine Schwager, 1876].
Family Calcarine SCHWAGER, 1876, p. 481.
Family Tinoporidea SCHWAGER, 1877, p. 21.
Subfamily Tinoporinae BRADY, 1884, p. 74 [*nom. transl. ex* family Tinoporidea Schwager, 1877].
Family Tinoporina LANKESTER, 1885, p. 847 [*nom. correct. pro* family Tinoporidea Schwager, 1877].
Family Tinoporinae DELAGE & HÉROUARD, 1896, p. 147 [*nom. correct pro* family Tinoporidea Schwager, 1877].
Family Tinoporidae LISTER *in* Lankester, 1903, p. 146 [*nom. correct. pro* family Tinoporidea Schwager, 1877].
Subfamily Calcarininae HOFKER, 1927, p. 42 [*nom. transl. ex* family Calcarinidae Eimer & Fickert, 1899].
Subfamily Tinoporininae HOFKER, 1933, p. 125 [*nom. van. pro* subfamily Tinoporinae Brady, 1884].
Family Siderolitidae FINLAY, 1939, p. 525.
Subfamily Siderolitinae SIGAL *in* Piveteau, 1952, p. 250 [*nom. transl. ex* family Siderolitidae Finlay, 1939].
Family Baculogypsinidae SMOUT, 1955, p. 205.

Test coiled, without differentiation into spiral and umbilical surfaces, advanced genera may become globular, large spines formed by thickenings, and not marginal projections of the chambers; canal system diffuse and confused with perforations.

Remarks.—Schwager (1876) used the term *Calcarine* in the family sense, although not actually in conjunction with the term "famiglia." All families used by Schwager in 1876 had the termination *-e* or *-ee* and all were italicized. Many of the family names which he used in conjunction with the term "famiglia" were formed identically, hence the family Calcarinidae is credited to Schwager.

Family ELPHIDIIDAE Galloway, 1933

Family Elphidiidae SIGAL *in* Piveteau, 1952, p. 240 [*nom. transl. ex* subfamily Elphidiinae Galloway, 1933].
Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].
Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud., nom. neg.*].
Family Helicotrochina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].
Subfamily Polystomellida SCHULTZE, 1854, p. 53.
Family Nautiloida SCHULTZE, 1854, p. 53 (*partim*) [*nom. nud.*].
Family Polystomellidea REUSS, 1862, p. 308, 388 [*nom. transl. ex* subfamily Polystomellida Schultze, 1854].
Subfamily Polystomellina JONES *in* Griffith & Henfrey, 1875, p. 320 [*nom. correct. pro* subfamily Polystomellida Schultze, 1854].
Subfamily Orbientina MARRIOTT, 1878, p. 30 [*nom. nud.*].
Subfamily Polystomellinae BRADY, 1881, p. 44 [*nom. correct. pro* subfamily Polystomellida Schultze, 1854].
Family Polystomellina LANKESTER, 1885, p. 848 [*nom. correct. pro* family Polystomellidea Reuss, 1862].
Family Polystomellinae DELAGE & HÉROUARD, 1896, p. 150 [*nom. correct. pro* family Polystomellidea Reuss, 1862].
Family Polystomellidae EIMER & FICKERT, 1899, p. 698 [*nom. correct. pro* family Polystomellidea Reuss, 1862].
Subfamily Elphidiinae GALLOWAY, 1933, p. 265.
Subfamily Cribroelphidiinae VOLOSHINOVA, 1958, p. 167.

Test planispiral, trochospiral or uncoiling; canal system opening into a single or double row of pores along the sutures, with retral processes projecting across the sutures; aperture interiomarginal, single or multiple, or areal.

Family NUMMULITIDAE Reuss, 1862

Family Nummulitidae EIMER & FICKERT, 1899, p. 706 [*nom. correct. pro* family Nummulitidea Reuss, 1862].
Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].
Family Enthomostègues D'ORBIGNY, 1826, p. 304 (*partim*) [*nom. nud.; nom. neg.*].
Family Helicosorina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].
Family Velellidae AGASSIZ, 1844, p. 5 (*partim*) [*nom. nud.*].
Family Nummulitidea REUSS, 1862, p. 308.
Family Nummulinida CARPENTER, PARKER

& JONES, 1862, p. 238 [*nom. correct. pro* family Nummulitidea Reuss, 1862].

Family Camerinidae MEEK & HAYDEN, 1865, p. 11.

Family Nummulitideae GÜMBEL, 1868, p. 84 [*nom. correct. pro* family Nummulitidea Reuss, 1862].

Family Nummuliti SCHWAGER, 1876, p. 477 [*nom. correct. pro* family Nummulitidea Reuss, 1862].

Family Nummulinidae SCHULZE, 1877, p. 29 [*nom. correct. pro* family Nummulinida Carpenter, Parker & Jones, 1862].

Family Nummulitina LANKESTER, 1885, p. 848 [*nom. correct. pro* family Nummulitidea Reuss, 1862].

Family Cycloclypeina LANKESTER, 1885, p. 848 [*nom. transl. ex* subfamily Cycloclypidae Bütschli, 1880].

Family Nummulinetta HAECKEL, 1894, p. 164 [*nom. correct. pro* family Nummulinida Carpenter, Parker & Jones, 1862].

Family Nummulitinae DELAGE & HÉROUARD, 1896, p. 152 [*nom. correct. pro* family Nummulitidea Reuss, 1862].

Family Cycloclypeinae DELAGE & HÉROUARD, 1896, p. 152 [*nom. correct. pro* family Cycloclypeina Lankester, 1885].

Family Cycloclypeidae GALLOWAY, 1933, p. 441 [*nom. correct. pro* family Cycloclypeina Lankester, 1885].

Family Nummulariidae WEDEKIND, 1937, p. 111

Family Nummulitida COPELAND, 1956, p. 188 [*nom. van. pro* family Nummulitidae Eimer & Fickert, 1899].

Test planispiral and bilaterally symmetrical; differentiated marginal cord with ramifying canals, canal system fine and ramifying, without vertical canals or fissures.

Subfamily NUMMULITINAE Reuss, 1862

Subfamily Nummulitinae BRADY, 1881, p. 44 [*nom. correct. pro* subfamily Nummulitidae Schwager, 1877].

Subfamily Nummulinina JONES *in* Griffith & Henfrey, 1875, p. 320 [*nom. transl. ex* family Nummulinida Carpenter, Parker & Jones, 1862].

Subfamily Nummulitidae SCHWAGER, 1877, p. 19 [*nom. transl. ex* family Nummulitidea Reuss, 1862].

Subfamily Camerininae CUSHMAN, 1928a, p. 209 [*nom. transl. ex* family Camerinidae Meek & Hayden, 1865].

Subfamily Assilininae PURI, 1957, p. 97. Chambers simple.

Subfamily CYCLOCLYPEINAE Bütschli, 1880

Subfamily Cycloclypeinae BRADY, 1884, p. 76 [*nom. correct. pro* subfamily Cycloclypidae Bütschli, 1880].

Subfamily Cycloclypidae BÜTSCHLI *in* Bronn, 1880, p. 215.

Subfamily Cycloclypeina CALKINS, 1901, p. 109 [*nom. correct. pro* subfamily Cycloclypidae Bütschli, 1880].

Subfamily Heteroclypeinae SCHUBERT, 1906, p. 640.

Subfamily Heterosteginae GALLOWAY, 1933, p. 421.

Chambers subdivided into chamberlets.

Family MIOGYPSINIDAE Vaughan, 1928

Family Miogypsinidae TAN, 1936a, p. 45 [*nom. transl. ex* subfamily Miogypsininae Vaughan, 1928].

Subfamily Miogypsininae VAUGHAN *in* Cushman, 1928a, p. 354.

Subfamily Miogypsinoidinae HANZAWA, 1947, p. 262.

Nepionic stage rotaloid, adult bilaterally symmetrical; orbitoidal median chambers eccentrically arranged around nucleoconch, and commonly with lateral chambers.

Superfamily GLOBIGERINACEA Carpenter, Parker & Jones, 1862, *nom. correct.*

Superfamily Globigerinacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Globigerinidea Morosova, 1957 and superfamily Globigerinaceae Banner & Blow, 1959].

Order Monostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxvii, 1 (*partim*) [*nom. neg.*].

Order Hélicostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 27 (*partim*) [*nom. neg.*].

Order Monostega DIESING, 1848, p. 497 (*partim*).

Monothalamia SCHULTZE, 1854, p. 52 (*partim*).

Turbinoidea REUSS, 1860, p. 151 (*partim*).

Helicostegia REUSS, 1860, p. 151, 205 (*partim*).
Tribe Perforata CLAUS, 1872, p. 108 (*partim*).
Division Monothalamia MARRIOTT, 1878, p. 30 (*partim*).
Order Globigerinidea LANKESTER, 1885, p. 847.
Subclass Perforata LANKESTER, 1885, p. 847 (*partim*).
Order Monothalamia HAECKEL, 1894, p. 164 (*partim*).
Suborder Globigerinidae DELAGE & HÉROUARD, 1896, p. 141.
Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 685 (*partim*) [*nom. nud.*].
Suborder Perforina CALKINS, 1901, p. 108 (*partim*).
Order Globigerinidae HARTOG *in* Harmer & Shipley, 1906, p. 59.
Order Globigerinida CALKINS, 1909, p. 39.
Order Dentata HOFKER, 1951, p. 14 (*partim*).
Suborder Deuteroforaminata HOFKER, 1951, p. 412 (*partim*).
Superfamily Bilamellidea REISS, 1957, p. 127 (*partim*) [*nom. nud.*].
Superfamily Globigerinidea MOROZOVA, 1957, p. 1110 [*nom. transl. ex* family Globigerinida Carpenter, Parker & Jones, 1862].
Order Heterohelicida FURSENKO, 1958, p. 24.
Superfamily Globigerinaceae BANNER & BLOW, 1959, p. 4 [*nom. correct. pro* superfamily Globigerinidea Morozova, 1957].

Test enrolled, planispiral or trochospiral or modified from such; chambers basically globular, later may be compressed or variously modified; double walls of lamellar radial hyaline calcite, distinctly perforate, may have canaliculate keels; aperture primarily formed, interiomarginal, or may be modified to become areal or terminal, single, or more rarely multiple, and may have secondary or accessory openings, may have apertural lips; habit planktonic, with resultant modifications including fine and elongate spines which support the frothy areolated ectoplasm.

Family HETEROHELICIDAE Cushman, 1927

Family Heterohelicidae CUSHMAN, 1927, p. 59.
Family Gümbelinidae WEDEKIND, 1937, p. 112 [*nom. transl. ex* subfamily Gümbelininae Cushman, 1927].
Family Heterohelicida COPELAND, 1956, p. 188 [*nom. van. pro* family Heterohelicidae Cushman, 1927].

Early stage planispiral, biserial or triserial, later may show serial reductions or proliferations; aperture large, simple and interiomarginal, or terminal in uniserial forms, without internal columellar processes.

Subfamily GUEMBELITRIINAE Montanaro Gallitelli, 1957

Subfamily Guembelitriinae MONTANARO GALLITELLI, 1957, p. 136.

Triserial, at least in young, later may develop proliferation of chambers; aperture simple.

Subfamily HETEROHELICINAE Cushman, 1927

Subfamily Heterohelicinae CUSHMAN, 1927, p. 59 [*nom. subst. pro* subfamily Spiroplectinae Cushman, 1911].
Subfamily Spiroplectinae CUSHMAN, 1911, p. 4.
Subfamily Gümbelininae CUSHMAN, 1927, p. 59 (*pro Gümbelina* Egger, 1899, *non Gümbelina* Kunze, 1895).

Early stage planispiral or biserial, later may develop chamber proliferation or serial reduction; aperture simple and interiomarginal, or terminal in uniserial forms.

Remarks.—The subfamily Spiroplectinae Cushman, 1911, is based on the genus *Spiroplecta* Ehrenberg, 1844, a junior isogenotypic synonym of *Heterohelix* Ehrenberg, 1841.

Family PLANOMALINIDAE Bolli, Loeblich & Tappan, 1957

Family Planomalinidae SIGAL, 1958, p. 263 [*nom. transl. ex* subfamily Planomalininae Bolli, Loeblich & Tappan, 1957].
Subfamily Planomalininae BOLLI, LOEBLICH & TAPPAN, 1957, p. 21.

Coiling planispiral, primary aperture equatorial, or symmetrically paired, umbilical portions of successive apertures remaining as relict secondary apertures.

Family SCHACKOINIDAE Pokorný, 1958

Family Schackoinidae POKORNÝ, 1958, p. 348.

Test trochospiral to nearly planispiral, each chamber with one or rarely more hollow tubulospines; aperture equatorial, and may have a broad spatulate lip.

Family ROTALIPORIDAE Sigal, 1958

Family Rotaliporidae SIGAL, 1958, p. 264.
Family Marginolamellidae HOFKER, 1951, p. 485 (*partim*) [*nom. nud.*].

Coiling trochospiral; primary aperture extraumbilical-umbilical, with relatively prominent lip, and may have secondary sutural apertures on the umbilical side which open into the posterior margin of the chambers.

Subfamily HEDBERGELLINAE Loeblich & Tappan, *subfam. nov.*

Primary aperture only, commonly with prominent apertural lip, those of previous chambers remaining as projections into the umbilical region. Type genus: *Hedbergella* Bronnimann & Brown, 1958.

Subfamily ROTALIPORINAE Sigal, 1958

Subfamily Rotaliporinae BANNER & BLOW, 1959, p. 8 [*nom. transl. ex* family Rotaliporidae Sigal, 1958].

With primary aperture, and secondary sutural apertures on the umbilical side.

Family GLOBOTRUNCANIDAE Brotzen, 1942

Family Globotruncanidae MOROZOVA, 1957, p. 1111 [*nom. transl. ex* subfamily Globotruncaninae Brotzen, 1942].
Subfamily Globotruncaninae BROTZEN, 1942, p. 28.
Family Marginolamellidae HOFKER, 1951, p. 485 (*partim*) [*nom. nud.*].
Subfamily Rugoglobigerininae SUBBOTINA *in* Rauser-Chernousova & Fursenko, 1959, p. 303.

Test trochospiral, chambers spherical to angular, commonly truncate or keeled; primary aperture umbilical, covered by spiral system of tegilla, with accessory intralaminal and infralaminal apertures.

Family HANTKENINIDAE Cushman, 1927

Family Hantkeninidae CUSHMAN, 1927, p. 64.

Test planispiral or enrolled biserial; chambers spherical to elongate or clavate; primary aperture symmetrical and equatorial, single or multiple, and may have relict or areal secondary apertures.

Subfamily HASTERIGERININAE Bolli, Loeblich & Tappan, 1957

Subfamily Hasterigerininae BOLLI, LOEBLICH & TAPPAN, 1957, p. 29.

Test planispiral; chambers spherical to clavate; primary aperture equatorial, without secondary apertures.

Subfamily HANTKENININAE Cushman, 1927

Subfamily Hantkenininae CHAPMAN & PARR 1936, p. 145 [*nom. transl. ex* family Hantkeninidae Cushman, 1927].

Test planispiral; chambers globular, elongate or spinate; aperture equatorial or areal and multiple.

Subfamily CASSIGERINELLINAE Bolli, Loeblich & Tappan, 1957

Subfamily Cassigerinellinae BOLLI, LOEBLICH & TAPPAN, 1957, p. 30.

Test planispiral in early stage, later enrolled biserial; chambers spherical to ovate; primary aperture equatorial in neanic stage, extraumbilical and alternating in the adult.

Family GLOBOROTALIIDAE Cushman, 1927

Family Globorotaliidae CUSHMAN, 1927, p. 91.
Family Marginolamellidae HOFKER, 1951, p. 485 (*partim*) [*nom. nud.*].

Test trochospiral; chambers ovate, spherical or angular; primary aperture interiomarginal, extraumbilical-umbilical, and secondary sutural apertures may occur on spiral side.

Subfamily GLOBOROTALIINAE Cushman, 1927

Subfamily Globorotaliinae CHAPMAN & PARR, 1936, p. 145 [*nom. transl. ex* family Globorotaliidae Cushman, 1927].

Primary aperture only, on the umbilical side.

Subfamily TRUNCOROTALOIDINAE Loeblich & Tappan, *subfam. nov.*

Primary aperture on umbilical side, and secondary sutural apertures on spiral side. Type genus: *Truncorotaloides* Bronnimann & Bermudez, 1953.

Family GLOBIGERINIDAE Carpenter, Parker & Jones, 1862

Family Globigerinidae SCHULZE, 1877, p. 29 [*nom. correct. pro* family Globigerinida Carpenter, Parker & Jones, 1862.

Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].

Family Uvellina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Family Turbinoidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 [*nom. nud.*].

Family Orbulinida SCHULTZE, 1854, p. 52.

Family Globigerinida CARPENTER, PARKER & JONES, 1862, p. 171 [*nom. conserv.* ICZN Op. 552].

Family Globigerinidee SCHWAGER, 1876, p. 479 [*nom. correct. pro* family Globigerinida Carpenter, Parker & Jones, 1862].

Family Globigerinidea SCHWAGER, 1877, p. 20 [*nom. correct. pro* family Globigerinida Carpenter, Parker & Jones, 1862].

Family Globigerininae BÜTSCHLI *in* Bronn, 1880, p. 200 [*nom. correct. pro* family Globigerinida Carpenter, Parker & Jones, 1862].

Family Orbulinetta HAECKEL, 1894, p. 164 [*nom. correct. pro* family Orbulinida Schultze, 1854].

Family Globigerinetta HAECKEL, 1894, p. 164 [*nom. correct. pro* family Globigerinida Carpenter, Parker & Jones, 1862].

Family Orbulinidae GALLOWAY, 1933, p. 326 [*nom. correct. pro* family Orbulinida Schultze, 1854].

Test trochospiral, streptospiral or globular; chambers spherical, ovate or clavate; primary aperture umbilical or spiroumbilical, may have secondary sutural or areal apertures and may have bullae and accessory infralaminal apertures.

Subfamily GLOBIGERININAE Carpenter, Parker & Jones, 1862

Subfamily Globigerininae CUSHMAN, 1927, p. 87 [*nom. correct. pro* subfamily Globigerinae Carpenter, Parker & Jones, 1862].

Subfamily Globigerinae CARPENTER, PARKER & JONES, 1862, p. 181.

Subfamily Globigerinina JONES *in* Griffith & Henfrey, 1875, p. 320 [*nom. correct. pro* subfamily Globigerinae Carpenter, Parker & Jones, 1862].

Subfamily Globigerinidae SCHWAGER, 1877, p. 20 [*nom. correct. pro* subfamily Globigerinae Carpenter, Parker & Jones, 1862].

Subfamily Pulleniatininae CUSHMAN, 1927, p. 89.

Test trochospiral to streptospiral; primary aperture umbilical or spiroumbilical, and may have secondary sutural apertures.

Subfamily SPHAEROIDINELLINAE Banner & Blow, 1959

Subfamily Sphaeroidinellinae BANNER & BLOW, 1959, p. 5.

Test trochospiral; chambers with flange-like margins; wall with secondary thickening and reduced perforations; primary aperture umbilical, and may have secondary sutural apertures.

Subfamily ORBULININAE Schultze, 1854

Subfamily Orbulininae CUSHMAN, 1927, p. 89 [*nom. transl. ex* family Orbulinida Schultze, 1854].

Subfamily Candeininae CUSHMAN, 1927, p. 90.

Test trochospiral to streptospiral, later stage enveloping or globular; primary aperture not visible in adult, secondary apertures multiple and sutural or areal.

Subfamily CATAPSYDRACINAE Bolli, Loeblich & Tappan, 1957

Subfamily Catapsydracinae BOLLI, LOEBLICH & TAPPAN, 1957, p. 36.

Subfamily Globigerinatellinae SIGAL, 1958, p. 263.

Subfamily Globorotaloidinae BANNER & BLOW, 1959, p. 7.

Test trochospiral to enveloping; chambers spherical to ovate; primary aperture umbilical, may have secondary sutural or areal apertures, one or more apertural bullae present in adult, with infralaminal accessory apertures.

Superfamily ORBITOIDACEA Schwager, 1876, *nom. correct.*

Superfamily Orbitoidacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily Orbitoidicae Bronnimann, 1958].

Tribu Polycyclica LATREILLE, 1825, p. 164 (*partim*).

Order Hélicostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 27 (*partim*) [*nom. neg.*].

Order Entomostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 113 (*partim*) [*nom. neg.*].

Order Cyclostègues D'ORBIGNY, 1851, p. 192 (*partim*) [*nom. neg.*].

Turbinoidea REUSS, 1860, p. 151 (*partim*).

Foraminifera Polymera REUSS, 1862, p. 365 (*partim*).

Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 685 (*partim*) [*nom. nud.*].

Basistoma SCHUBERT, 1920, p. 148 (*partim*).

Family group Flexostylidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 87 (*partim*).

Order Flexostylidia CALKINS, 1926, p. 355 (*partim*).

Order Orthostili (Perforata) SILVESTRI, 1937, p. 89 (*partim*).

Order Dentata HOFKER, 1951, p. 14 (*partim*).

Suborder Deuteroforaminata HOFKER, 1951, p. 412 (*partim*).

Superfamily Bilamellidea REISS, 1957, p. 127 (*partim*) [*nom. nud.*].

Superfamily Orbitoidicae BRONNIMANN, 1958, p. 167 [*nom. transl. ex* family Orbitoidee Schwager, 1876].

Test basically coiled, with radial laminated calcite walls, primarily formed double septa, walls of two layers, outer lamella covering all previously deposited parts of test as well as forming new chamber, inner lining confined to each chamber and wedging out at the margins, present on the distal face of the chamber interior, on its roof and lateral walls.

Family ANOMALINIDAE Cushman, 1927

Family Anomalinidae CUSHMAN, 1927, p. 92.

Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].

Subfamily Anomalininae CUSHMAN, 1927, p. 92.

Subfamily Praerotalininae HOFKER, 1933, p. 125 (*partim*) [*nom. nud.*].

Subfamily Planulininae BERMUDEZ, 1952, p. 91.

Test trochospiral to nearly planispiral, evolute on one or both sides; chambers simple; single primary aperture, interiomarginal, nearly equatorial; wall coarsely perforate.

Family AMPHISTEGINIDAE Cushman, 1927

Family Amphisteginidae CUSHMAN, 1927, p. 79.

Family Enthomostègues D'ORBIGNY, 1826, p. 304 (*partim*) [*nom. nud.; nom. neg.*].

Family Helicotrochina EHRENBERG, 1839, table opposite p. 120 (*partim*) [*nom. nud.*].

Subfamily Amphistegininae CHAPMAN & PARR, 1936, p. 144 [*nom. transl. ex* family Amphisteginidae Cushman, 1927].

Test trochospiral, involute, with supplementary chambers on the umbilical side; aperture between the secondary partition and the periphery.

Family CYMBALOPORIDAE Cushman, 1927

Family Cymbaloporidae CUSHMAN, 1927, p. 81.

Family Cymbaloporettidae CUSHMAN, 1928b, p. 8.

Subfamily Cymbaloporinae CHAPMAN & PARR, 1936, p. 143 [*nom. transl. ex* family Cymbaloporidae Cushman, 1927].

Family Halkyardiidae KUDO, 1931, p. 201.

Test trochospiral, later chambers in annular series in a single flat or conical layer; apertures numerous, variously arranged circular pores.

Family HOMOTREMIDAE Cushman, 1927

Family Homotremidae CUSHMAN, 1927, p. 97.

Family Rupertiidae CUSHMAN, 1927, p. 96 [*nom. nud.;* based on *Rupertia* Wallich, 1877, not *Rupertia* Gray, 1865, Mollusca].

Family Victoriellidae CHAPMAN & CRESPIN, 1930, p. 111.

Family Polytremidae CHAPMAN, PARR & COLLINS, 1934, p. 556, 573.

Family Miniacinidae THALMANN, 1938, p. 208 [*nom. subst. pro* family Polytremidae Chapman, Parr & Collins, 1934, which was based on *Polytrema* of authors (= *Miniacina* Galloway, 1933), not *Polytrema* Risso, 1826, bryozoan, and not *Polytrema* Rafinesque, 1819, crinoid].

Family Eorupertiidae COLE, 1957, p. 337 [*nom. subst. pro* family Victoriellidae Chapman & Crespin, 1930, as genus *Victoriella* Chapman & Crespin, 1930,

was regarded by Cole as a junior synonym of *Eorupertia* Yabe & Hanzawa, 1925].

Test attached, early chambers irregularly trochospiral, later variously modified; wall coarsely perforate.

Subfamily RUPERTININAE Loeblich & Tappan, *nom. nov.*

Subfamily Rupertininae LOEBLICH & TAPPAN, herein [*nom. subst. pro* subfamily Rupertiinae Galloway, 1933, *nom. nud.*].

Subfamily Rupertiinae GALLOWAY, 1933, p. 302 [*nom. transl. ex* family Rupertiidae Cushman, 1927; *nom. nud.*].

Subfamily Rupertinae SILVESTRI, 1937, p. 143 [*nom. van. pro* subfamily Rupertiinae Galloway, 1933; *nom. nud.*].

Test attached, early chambers trochospiral, later extending upward from the base in a loose spiral or becoming an irregular rounded mass; aperture interiomarginal or may become terminal, single or multiple. Type genus: *Rupertina* Loeblich & Tappan, *nom. nov.*

Remarks.—Rupertina, nom. nov. is herein proposed for *Rupertia* Wallich, 1877, Ann. Mag. Nat. Hist. ser. 4, vol. 19, p. 502 [*non Rupertia* Gray, 1865, Mollusca]. Type species: *Rypertina stabilis* (Wallich) = *Rupertia stabilis* Wallich, 1877.

Subfamily HOMOTREMINAE Cushman, 1927

Subfamily Homotreminae CHAPMAN & PARR 1936, p 144 [*nom. transl. ex* family Homotremidae Cushman, 1927].

Subfamily Homotrematinae POKORNÝ, 1958, p. 333 [*nom. van. pro* subfamily Homotreminae Chapman & Parr, 1936].

Test attached, early stage trochospiral, later growth irregular, and extending upward from attachment, becoming branched; apertures large, and may be covered by perforated plate.

Family ORBITOIDIDAE Schwager, 1876

Family Orbitoididae EIMER & FICKERT, 1899, p. 688 [*nom. correct. pro* family Orbitoidee Schwager, 1876].

Family Orbitoidee SCHWAGER, 1876, p. 481.

Family Orbitoidinae SILVESTRI, 1907, p. 12 [*nom. van. pro* family Orbitoididae Eimer & Fickert, 1899].

Family Orbitoidae SILVESTRI, 1937, p. 155 [*nom. van. pro* family Orbitoididae Eimer & Fickert, 1899].

Family Orbitoidida COPELAND, 1956, p. 188 [*nom. van. pro* family Orbitoididae Eimer & Fickert, 1899].

Family Pseudorbitoididae BRONNIMANN, 1958, p. 167 [*nom. transl. ex* subfamily Pseudorbitoidinae M. G. Rutten, 1935].

Family Lepidorbitoididae POKORNÝ, 1958, p. 388 [*nom. transl. ex* subfamily Lepidorbitoidinae Vaughan, 1933].

Test large, discoidal or variously modified, equatorial layer of chambers may become multiple near periphery, equatorial zone covered on both sides by lateral chambers either arranged in regular tiers or overlapping, early stage spiral in microspheric generation, multilocular embryonic apparatus in megalospheric generation, no canal system, but with stoloniferous apertures between chambers.

Subfamily OMPHALOCYCLINAE Vaughan, 1928

Subfamily Omphalocyclinae VAUGHAN *in* Cushman, 1928a, p. 336, 355.

Lateral chamberlets nearly or completely absent, equatorial chambers of greater height than radial dimension; four-chambered embryonic stage surrounded by thickened wall.

Subfamily ORBITOIDINAE Schwager, 1876

Subfamily Orbitoidinae PREVER, 1904, p. 111 [*nom. transl. ex* family Orbitoidee Schwager, 1876].

With lateral chambers and chamberlets, chambers with four stolons, and annular stolons of variable number; embryonic stage with two to four chambers (rarely more) and surrounded by a thickened wall.

Subfamily PSEUDORBITOIDINAE M. G. Rutten, 1935

Subfamily Pseudorbitoidinae M. G. RUTTEN, 1935, p. 544.

Embryonic biloculine stage followed by irregularly spiral single series of chambers; chambers irregular, with radial plates cutting across chamber walls and cavities.

Subfamily CLYPEORBINAE Sigal, 1952

Subfamily Clypeorbinae SIGAL *in* Piveteau, 1952, p. 259.

Exterior asymmetrical; nucleoconch composed of trochospiral series of four to five chambers, followed by equatorial chambers.

Subfamily LEPIDORBITOIDINAE Vaughan, 1933

Subfamily Lepidorbitoidinae VAUGHAN *in* Cushman, 1933, p. 285.

Nucleoconch biloculine, second chamber larger than proloculus; equatorial chambers spatulate or hexagonal or arched.

Family DISCOCYCLINIDAE Galloway, 1928

Family Discocyclinidae VAUGHAN & COLE *in* Cushman, 1940, p. 327 [*nom. transl. ex* subfamily Discocyclininae Galloway, 1928].

Family Orthophragminidae WEDEKIND, 1937, p. 123, 124.

Family Asterocyclinidae BRONNIMANN, 1951, p. 208.

Family Orbitoclypeidae POKORNÝ, 1958, p. 393 [*nom. transl. ex* subfamily Orbitoclypeinae Bronnimann, 1946].

Test flat or discoidal, protoconch partly or completely surrounded by deuteroconch, equatorial chambers concentric, arched or annular, subdivided into chamberlets which communicate by means of radial and annular stolons, with vertical stolons between the numerous small lateral chamberlets; intraseptal canals radial and annular.

Subfamily DISCOCYCLININAE Galloway, 1928

Subfamily Discocyclininae GALLOWAY, 1928, p. 55.

Subfamily Orthophragmininae WEDEKIND, 1937, p. 125.

Nepionic stage with spiralling chambers, later ones annular and subdivided into chamberlets; neanic stage with annular chambers divided by secondary radial partitions, equatorial layer of chamberlets.

Subfamily ORBITOCLYPEINAE Bronnimann, 1946

Subfamily Orbitoclypeinae BRONNIMANN, 1946, p. 612.

Chambers of nepionic stage in a short spiral and not subdivided, those of neanic stage roughly concentric, alternating or imbricating, not resulting from the subdivision of annular chambers, equatorial layer of chambers present.

Family HELICOLEPIDINIDAE Tan, 1936

Family Helicolepidinidae POKORNÝ, 1958, p. 395 [*nom. transl. ex* subfamily Helicolepidininae Tan, 1936].

Subfamily Helicolepidininae TAN, 1936b, p. 277.

Subfamily Helicolepidinae VAUGHAN & COLE *in* Cushman, 1940, p. 325 [*nom. van. pro* subfamily Helicolepidininae Tan, 1936].

Test basically trochospiral, with spiral growth persisting beyond embryonic stage; biloculine embryonic stage with deuteroconch smaller than protoconch, early chambers simple, later ones subdivided into chamberlets on umbilical side; chamberlets arched to hexagonal and with diagonal or radial stolons; lateral chamberlets communicate by means of pores and stolons; aperture of spiral chambers sub-basal.

Family LEPIDOCYCLINIDAE Scheffen, 1932

Family Lepidocyclinidae SCHEFFEN, 1932, p. 251, 252.

Subfamily Lepidocyclininae TAN, 1936b, p. 277 [*nom. transl. ex* family Lepidocyclinidae Scheffen, 1932].

Subfamily Lepidocyclinae VAUGHAN & COLE *in* Cushman, 1940, p. 357 [*nom. van. pro* subfamily Lepidocyclininae Tan, 1936].

Similar to Orbitoididae but with smaller (usually biloculine) embryonic stage, with equatorial and lateral layers of chambers, equatorial layer thinner, lateral chamberlets with thin walls; no canal system.

Superfamily CASSIDULINACEA d'Orbigny, 1839, *nom. transl.*

Superfamily Cassidulinacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Cassidulinidae d'Orbigny, 1839].

Tribu Polycyclica LATREILLE, 1825, p. 164 (*partim*).

Tribu Nantilites LATREILLE, 1825, p. 165 (*partim*).

Order Enallostègues D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 125 (*partim*) [*nom. neg.*].

Order Hélicostègues D'ORBIGNY *in* de la

Sagra, 1839, p. xxxviii, 27 (*partim*) [*nom. neg.*].

Group Helicoidea SCHULTZE, 1854, p. 53 (*partim*).

Helicostegia REUSS, 1860, p. 151, 203 (*partim*).

Turbinoidea REUSS, 1860, p. 151 (*partim*).

Nautiloidea REUSS, 1860, p. 151 (*partim*).

Foraminifera Polymera REUSS, 1862, p. 365 (*partim*).

Subclass Perforata LANKESTER, 1885, p. 847 (*partim*).

Order Chilostomellidea LANKESTER, 1885, p. 847.

Order Perforida DELAGE & HÉROUARD, 1896, p. 135 (*partim*).

Suborder Chilostomellidae DELAGE & HÉROUARD, 1896, p. 138.

Superfamily Enclinostegia EIMER & FICKERT, 1899, p. 682 (*partim*) [*nom. nud.*].

Superfamily Orthoklinostegia EIMER & FICKERT, 1899, p. 685 (*partim*) [*nom. nud.*].

Suborder Perforina CALKINS, 1901, p. 108 (*partim*).

Order Cheilostomellaceae HARTOG *in* Harmer & Shipley, 1906, p. 59.

Order Chilostomellida CALKINS, 1909, p. 39.

Family group Textulinidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 88 (*partim*).

Order Textulinida CALKINS, 1926, p. 356 (*partim*).

Family group Rotaliformes BROTZEN, 1942, p. 9 (*partim*) [*nom. neg.*].

Order Dentata HOFKER, 1951, p. 14 (*partim*).

Suborder Protoforaminata HOFKER, 1951, p. 42 (*partim*).

Suborder Biforaminata HOFKER, 1951, p. 306 (*partim*).

Suborder Pluriloculinidea SIGAL *in* Piveteau, 1952, p. 160 (*partim*).

Superfamily Monolamellidea REISS, 1957, p. 128 (*partim*) [*nom. nud.*].

Superfamily Bilamellidea REISS, 1957, p. 127 (*partim*) [*nom. nud.*].

Superfamily Nonionidea SUBBOTINA *in* Rauser-Chernousova & Fursenko, 1959, p. 282 [*nom. transl. ex* subfamily Nonionida Schultze, 1854].

Test enrolled, planispiral, or low or high trochospiral; wall of perforate granular calcite; aperture slitlike, loop-shaped or multiple.

Family CAUCASINIDAE Bykova, 1959, *nom. transl.*

Family Caucasinidae LOEBLICH & TAPPAN, herein [*nom. transl. ex* subfamily Caucasininae Bykova, 1959].

Family Virgulinidae HOFKER, 1951, p. 236 [*nom. transl. ex* subfamily Virgulininae Cushman, 1927; *nom. nud.*].

Family Enallostègues D'ORBIGNY, 1826, p. 260 (*partim*) [*nom. nud.; nom. neg.*].

Test elongate, early stage spiral about an elongate axis, later may become uniserial; aperture loop-shaped, with internal toothplate connecting those of adjacent chambers.

Subfamily FURSENKOININAE Loeblich & Tappan, *nom. nov.*

Subfamily Fursenkoininae LOEBLICH & TAPPAN, herein [*nom. subst. pro* subfamily Virgulininae Cushman, 1927, *nom. nud.*].

Subfamily Virgulininae CUSHMAN, 1927, p. 68 [*nom. nud.;* based on *Virgulina* d'Orbigny, 1826; *non Virgulina* Bory de St. Vincent, 1823 (Vermes, trematode)].

Test basically biserial, but distinctly twisted, later may become uniserial; aperture loop-shaped in biserial stage, becoming terminal in uniserial stage. Type genus: *Fursenkoina* Loeblich & Tappan, *nom. nov.*

Remarks.—*Fursenkoina nom. nov.* is herein proposed for *Virgulina* d'Orbigny, 1826, Ann. Sci. Nat. v. 7, p. 267 (*non Virgulina* Bory de St. Vincent, 1823). Type species: *Fursenkoina squammosa* (d'Orbigny) = *Virgulina squammosa* d'Orbigny, 1826.

Subfamily CAUCASININAE Bykova, 1959

Subfamily Caucasininae BYKOVA *in* Rauser-Chernousova & Fursenko, 1959, p. 328.

Early stage trochospiral, later biserial; aperture a loop in the apertural face.

Remarks.—Although no information is available as to the microstructure of the wall of the type species of *Caucasina*, the genus *Aeolostreptis* Loeblich & Tappan, 1957 (which on the basis of descriptions and illustrations appears to be a junior synonym of *Caucasina* Chalilov, 1951) has a distinctly granular wall. Hence the subfam-

ily and family are here placed in the *Cassidulinacea* and removed from the *Buliminacea*.

Family DELOSINIDAE Parr, 1950

Family Delosinidae PARR, 1950, p. 345.

Test triserial; no primary aperture, but large sutural pores open into a subsutural canal.

Family PLEUROSTOMELLIDAE Reuss, 1860

Family Pleurostomellidae REUSS, 1860, p. 151, 203.

Family Pleurostomellideae GÜMBEL, 1868, p. 52 [*nom. correct. pro* family Pleurostomellidae Reuss, 1860].

Family Ellipsoidinidae CUSHMAN, 1926, p. 590.

Family Pleurostomellida COPELAND, 1956, p. 188 [*nom. van. pro* family Pleurostomellidae Reuss, 1860].

Early stage triserial or biserial, later uniserial or uniserial throughout; aperture a curved narrow slit, lateral or terminal, with internal siphon between those of adjacent chambers.

Subfamily WHEELERELLINAE Petters, 1954

Subfamily Wheelerellinae PETTERS, 1954, p. 39.

Early stage triserial, later uniserial.

Subfamily PLEUROSTOMELLINAE Reuss, 1860, *nom. correct.*

Subfamily Pleurostomellinae LOEBLICH & TAPPAN, herein [*nom. correct. pro* subfamily Pleurostomellidea Reuss, 1862].

Subfamily Pleurostomellidea REUSS, 1862, p. 368 [*nom. transl. ex* family Pleurostomellidae Reuss, 1860].

Subfamily Cryptostegia BÜTSCHLI *in* Bronn, 1880, p. 203 [*nom. transl. ex* family Cryptostegia Reuss, 1862, *nom. nud.*].

Subfamily Ellipsonodosariinae SILVESTRI, 1901, p. 109.

Subfamily Stilostomellinae FINLAY, 1947, p. 275.

Subfamily Ellipsoidininae PETTERS, 1954, p. 39 [*nom. transl. ex* family Ellipsoidinidae Cushman, 1926].

Early stage biserial, later uniserial, or uniserial throughout.

Family NONIONIDAE Schultze, 1854

Family Nonionidae CUSHMAN, 1927, p. 49 [*nom. transl. ex* subfamily Nonionida Schultze, 1854].

Family Polythalama LATREILLE, 1825, p. 161 (*partim*) [*nom. nud.*].

Family Hélicostègues D'ORBIGNY, 1826, p. 268 (*partim*) [*nom. nud.; nom. neg.*].

Family Nautiloida SCHULTZE, 1854, p. 53 (*partim*) [*nom. nud.*].

Family Nautiloidea REUSS, 1860, p. 151 (*partim*) [*nom. correct. pro* family Nautiloida Schultze, 1854; *nom. nud.*].

Family Nonioninidae REUSS, 1860, p. 151.

Family Nonioninideae REUSS, 1860, p. 221 [*nom. correct. pro* family Nonioninidae Reuss, 1860].

Family Cryptostegia REUSS, 1862, p. 320, 372 [*nom. nud.*].

Family Chilostomellidae BRADY, 1881, p. 42, 44.

Family Melonidae CHAPMAN, PARR & COLLINS, 1934, p. 556.

Family Canaliferidae KRASHENINNIKOV, 1953, p. 88.

Family Nonionidea COPELAND, 1956, p. 187 [*nom. van. pro* family Nonionidae Cushman, 1927].

Family Chilostomellida COPELAND, 1956, p. 187 [*nom. van. pro* family Chilostomellidae Brady, 1881].

Test planispiral or trochospiral; aperture interiomarginal or areal.

Subfamily CHILOSTOMELLINAE Brady, 1881

Subfamily Chilostomellinae SILVESTRI, 1906 p. 12 (23) [*nom. transl. ex* family Chilostomellidae Brady, 1881].

Subfamily Cryptostegia BÜTSCHLI *in* Bronn, 1880, p. 203 (*partim*) [*nom. transl. ex* family Cryptostegia Reuss, 1862; *nom. nud.*].

Subfamily Allomorphininae CUSHMAN, 1927, p. 85.

Subfamily Allomorphinellinae CUSHMAN, 1927, p. 86.

Test trochospiral, few chambers per whorl, later biserial or planispiral and involute; aperture interiomarginal on the umbilical side.

Subfamily NONIONINAE Schultze, 1854

Subfamily Nonioninae CHAPMAN & PARR, 1936, p. 145 [*nom. correct. pro* subfamily Nonionida Schultze, 1854].
Subfamily Nonionida SCHULTZE, 1854, p. 53.
Subfamily Pullenidae SCHWAGER, 1877, p. 18.
Subfamily Pulleninae BÜTSCHLI *in* Bronn, 1880, p. 210 [*nom. correct. pro* subfamily Pullenidae Schwager, 1877].
Subfamily Nonionininae SILVESTRI, 1950, p. 52 [*nom. transl. ex* family Nonioninidae Reuss, 1860].
Subfamily Nonionellinae VOLOSHINOVA, 1958, p. 141.
Subfamily Melonisinae VOLOSHINOVA, 1958, p. 147 [*nom. transl. ex* family Melonidae Chapman, Parr & Collins, 1934].

Test planispiral and involute to slightly trochospiral; aperture interiomarginal and equatorial, or areal and multiple.

Family CASSIDULINIDAE d'Orbigny, 1839

Family Cassidulinidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxix, 123.
Subfamily Cassidulinida SCHULTZE, 1854, p. 52 [*nom. transl. ex* family Cassidulinidae d'Orbigny, 1839].
Family Turbinoida SCHULTZE, 1854, p. 52 (*partim*) [*nom. nud.*].
Family Cassidulinidea REUSS, 1862, p. 373 [*nom. correct. pro* family Cassidulinidae d'Orbigny, 1839].
Subfamily Cassidulinae BRADY, 1881, p. 44 [*nom. transl. ex* family Cassidulinidae d'Orbigny, 1839].
Subfamily Cassidulininae BRADY, 1884, p. 69 [*nom. correct pro* subfamily Cassidulinae Brady, 1881].
Family Cassidulina LANKESTER, 1885, p. 847 [*nom. correct. pro* family Cassidulinidae d'Orbigny, 1839].
Family Cassiduline DELAGE & HÉROUARD, 1896, p. 14 [*nom. correct. pro* family Cassidulinidae d'Orbigny, 1839].
Subfamily Cassidulineae CALKINS, 1901, p. 108 [*nom. correct. pro* subfamily Cassidulinae Brady, 1881].
Subfamily Ehrenbergininae CUSHMAN, 1927, p. 84.
Family Cassidulinida COPELAND, 1956, p. 188 [*nom. van. pro* family Cassidulinidae d'Orbigny, 1839].

Test lenticular, subglobular or elongate; chambers biserially arranged, the alternating chambers also planispirally enrolled at least in the early stage, later may be uncoiled; aperture elongate, comma-shaped, a slit extending from the basal suture into the apertural face.

Family ALABAMINIDAE Hofker, 1951

Family Alabaminidae HOFKER, 1951, p. 389.
Family Turbinoidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 (*partim*) [*nom. nud.*].
Subfamily Pseudoparellinae VOLOSHINOVA *in* Voloshinova & Dain, 1952, p. 81.
Family Parrelloididae HOFKER, 1956a, p. 936.
Family Pseudoparrellidae SUBBOTINA *in* Rauser-Chernousova & Fursenko, 1959, p. 272 [*nom. correct.* and *nom. transl. ex* subfamily Pseudoparellinae Voloshinova, 1952].

Test lenticular, trochospiral; septa single-layered; aperture basal, or a slit extending up the apertural face, or both.

Family CIBICIDIDAE Cushman, 1927

Family Cibicididae CHAPMAN, PARR & COLLINS, 1934, p. 556, 570 [*nom. transl. ex* subfamily Cibicidinae Cushman, 1927].
Family Turbinoidae D'ORBIGNY *in* de la Sagra, 1839, p. xxxviii, 71 (*partim*) [*nom. nud.*].
Family Turbinoidea REUSS, 1860, p. 151 (*partim*) [*nom. correct. pro* family Turbinoidae d'Orbigny, 1839; *nom. nud.*].
Family Cibicidae HOFKER, 1951, p. 332 [*nom. van. pro* family Cibicididae Chapman, Parr & Collins, 1934].
Family Gavelinellidae HOFKER, 1956a, p. 946.

Test trochospiral to nearly planispiral; septa double; aperture interiomarginal, may extend onto spiral side, and peripheral supplementary apertures may occur.

Subfamily GAVELINELLINAE Hofker, 1956, *nom. transl.*

Subfamily Gavelinellinae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Gavelinellidae Hofker, 1956].

Primary aperture umbilical, with distinct lip, secondary aperture sutural in position.

Subfamily CIBICIDINAE Cushman, 1927

Subfamily Cibicidinae CUSHMAN, 1927, p. 93.

Subfamily Truncatulininae SCHUBERT, 1920, p. 151.

Subfamily Orbitorotalininae HOFKER, 1933, p. 125 [*nom. nud.*].

Interiomarginal, equatorial primary aperture only, which may extend onto the spiral side.

Remarks.—The Truncatulininae Schubert, 1920 is based on *Truncatulina* d'Orbigny 1826, a junior synonym of *Cibicides* Montfort, 1808.

Subfamily ALMAENINAE Mjatliuk, 1959

Subfamily Almaeninae MJATLIUK *in* Rauser-Chernousova & Fursenko, 1959, p. 272.

Primary aperture interiomarginal, equatorial or slightly umbilical, with a lip; secondary slitlike aperture at the peripheral margin, in the plane of coiling.

Superfamily ROBERTINACEA Reuss, 1850, *nom. transl.*

Superfamily Robertinacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Robertinidae Reuss, 1850].

Order Dentata HOFKER, 1951, p. 14 (*partim*).

Suborder Biforaminata HOFKER, 1951, p. 306 (*partim*).

Superfamily Ceratobuliminidea MJATLIUK *in* Rauser-Chernousova & Fursenko, 1959, p. 273.

Test trochospiral, chambers divided internally by partitions which become more important in advanced forms; wall perforate radial in structure, of aragonite; aperture a low slit in the chamber face, with secondary aperture in each septum above the partition.

Family CERATOBULIMINIDAE Cushman, 1927

Family Ceratobuliminidae GLAESSNER, 1937a, p. 27 [*nom. transl. ex* subfamily Ceratobulimininae Cushman, 1927].

Family Epistominidae WEDEKIND, 1937, p. 115.

Family Ceratubuliminidae HOFKER, 1956b, p. 103 [*nom. null. pro* family Ceratobuliminidae Glaessner, 1937].

Test trochospiral, primary aperture closed when new chambers added, and new foramen opened by resorption above the internal partition.

Subfamily CERATOBULIMININAE Cushman, 1927

Subfamily Ceratobulimininae CUSHMAN, 1927, p. 84.

Primary aperture interiomarginal; coiling predominantly dextral.

Subfamily EPISTOMININAE Wedekind, 1937, *nom. transl.*

Subfamily Epistomininae LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Epistominidae Wedekind, 1937].

Subfamily Praerotalininae HOFKER, 1933, p. 125 (*partim*) [*nom. nud.*].

Coiling predominantly sinistral; primary aperture on peripheral margin of chambers; internal partition joins to dorsal lip of aperture.

Family ROBERTINIDAE Reuss, 1850

Family Robertinidae REUSS, 1850, p. 375.

Subfamily Robertininae SIGAL *in* Piveteau, 1952, p. 220 [*nom. transl. ex* family Robertinidae Reuss, 1850].

Test a high trochospiral, coiling predominantly dextral; septal foramen homologous with part of primary aperture, not a secondary feature as in the Ceratobuliminidae.

Superfamily CARTERINACEA Loeblich & Tappan, 1955, *nom. transl.*

Superfamily Carterinacea LOEBLICH & TAPPAN, herein [*nom. transl. ex* family Carterinidae Loeblich & Tappan, 1955].

Test composed of secreted fusiform calcareous spicules, commonly oriented parallel to the periphery, and embedded in a calcareous ground mass.

Family CARTERINIDAE Loeblich & Tappan, 1955

Family Carterinidae LOEBLICH & TAPPAN, 1955, p. 27.

Test trochospiral, free or attached; later chambers subdivided by secondary septa.

Superfamily SPIRILLINACEA Reuss, 1862, *nom. correct.*

Superfamily Spirillinacea LOEBLICH & TAPPAN, herein [*nom. correct. pro* superfamily

Spirillinoidea Chapman, Parr & Collins, 1934, and superfamily Spirillinidea Pokorný, 1958].

Foraminifera Monomera REUSS, 1862, p. 362 (*partim*).

Suborder Perforina CALKINS, 1901, p. 108 (*partim*).

Family Group Archi-Monothalamidia RHUMBLER *in* Kükenthal & Krumbach, 1923, p. 85 (*partim*).

Superfamily Spirillinoidea CHAPMAN, PARR & COLLINS, 1934, p. 554 [*nom. transl. ex* family Spirillinidea Reuss, 1862].

Suborder Biloculinidea SIGAL *in* Piveteau, 1952, p. 157 (*partim*).

Order Monosomatia COPELAND, 1956, p. 183 (*partim*).

Superfamily Spirillinidea POKORNÝ, 1958, p. 311 [*nom. correct. pro* superfamily Spirillinoidea Chapman, Parr & Collins, 1934].

Proloculus followed by enrolled tubular second chamber, non-septate or with septa in later stages, becoming biserial, may develop annular chambers; wall perforate, calcareous, consisting optically of a single crystal of calcite; amoeboid gametes in plastogamic reproductive cycle; quadrinucleate.

Family SPIRILLINIDAE Reuss, 1862

Family Spirillinidae RHUMBLER, 1895b, p. 85 [*nom. correct. pro* family Spirillinidea Reuss, 1862].

Family Spirillinidea REUSS, 1862, p. 364.

Family Spirillinina LANKESTER, 1885, p. 847 [*nom. correct. pro* family Spirillinidea Reuss, 1862].

Family Spirillinae DELAGE & HÉROUARD, 1896, p. 144 [*nom. correct. pro* family Spirillinidea Reuss, 1862].

Characters as in the superfamily.

Subfamily SPIRILLININAE Reuss, 1862

Subfamily Spirillininae BRADY, 1884, p. 72 [*nom. transl. ex* family Spirillinidea Reuss, 1862].

Subfamily Arspirillinia RHUMBLER, 1913, p. 388 [*nom. van. pro* subfamily Spirillininae Brady, 1884].

Subfamily Turrispirillininae CUSHMAN, 1927 p. 73.

Subfamily Terebralininae CUSHMAN, 1927, p. 65.

Test with proloculus and enrolled tubular, non-septate second chamber only; aperture simple, single, at open end of the tube.

Subfamily PATELLININAE Rhumbler, 1906

Subfamily Patellininae RHUMBLER, 1906, p. 35.

Subfamily Arpatellinia RHUMBLER, 1913, p. 390 [*nom. van. pro* subfamily Patellininae Rhumbler, 1906].

Proloculus and trochospirally coiled non-septate chamber in early stage, followed by septate stage with two chambers per whorl, or annular chambers; aperture umbilical.

Order XENOPHYOPHORIDA Schulze, 1904, *nom. correct.*

Order Xenophyophorida LOEBLICH & TAPPAN, herein [*nom. correct. pro* Xenophyophora Schulze, 1904].

Order Domatocoela HAECKEL, 1889, p. 8 (*partim*).

Gruppe Xenophyophora SCHULZE, 1904, p. 1387.

Xenophyophoren SCHULZE, 1905, p. 6 [*nom. neg.*].

Order Xenophyophora SCHULZE, 1912, p. 41.

Myxozoa SCHEPOTIEFF, 1912, p. 267 (*partim*).

Mycetozoida SCHEPOTIEFF, 1912, p. 267 (*partim*).

Order Psamminidea POCHE, 1913, p. 202.

Order Xenophiophorae CHATTON, 1925, p. 76.

Suborder Xenophyophora JÍROVEC, 1953, p. 335.

Multinucleate plasmodium containing numerous clear solid bodies (granellae), and forming a pseudopodial network enclosed in a system of hollow tubes (granellarium), some of the tubes (stercomarium) also containing dark bodies (sterkomata), probably of faecal nature; tube system composed of hyaline organic substance resembling spongin, and interspaces contain foreign matter (xenophya), including sand grains, and tests of foraminifera, radiolaria or diatoms; reproduction probably by swarm spores.

Family STANNOMIDAE Haeckel, 1889

Family Stannomidae HAECKEL, 1889, p. 7, 8, 54.

Family Xenophyophoridae LANKESTER, 1909, p. 286 (*partim*) [*nom. nud.*].

Subfamily Stannomida LANKESTER, 1909, p. 286 [*nom. transl. ex* family Stannomidae Haeckel, 1889].

Subfamily Neusininae CUSHMAN, 1910, p. 129.

Family Neusinidae CUSHMAN, 1927, p. 29 [*nom. transl. ex* subfamily Neusininae Cushman, 1910].

Xenophya held together by spongin-like threads (linellae) with expanded attachments; body flexible.

Remarks.—*Neusina agassizii* Goës, 1892 (basis for the family Neusinidae, which has commonly been included in the Foraminiferida), has been shown to be identical with *Stanophyllum zonarium* Haeckel, 1889.

Family PSAMMINIDAE Haeckel, 1889

Family Psamminidae HAECKEL, 1889, p. 7, 8, 32.

Subfamily Psamminae LENDENFELD, 1886, p. 589 [*nom. nud.*].

Subfamily Psamminidae LANKESTER, 1909, p. 286 [*nom. transl. ex* family Psamminidae Haeckel, 1889].

Family Xenophyophoridae LANKESTER, 1909, p. 286 (*partim*) [*nom. nud.*].

Body not flexible; no linellae present.

Remarks.—The subfamily Psamminae Lendenfeld, 1886 was not based on the genus *Psammina* Haeckel, 1889, but on the manuscript name *Psammella* Lendenfeld (*nom. nud.*) which was never described in publication.

Order LABYRINTHULIDA Lankester, 1877

Order Labyrinthulida LANKESTER, 1877, p. 442.

Monadinen (Monadineae) ZOPF, 1885, p. 98 (*partim*).

Monadineae azoosporeae ZOPF, 1885, p. 99.

Class Proteomyxa LANKESTER, 1885, p. 839.

Class Labyrinthulidea LANKESTER, 1885, p. 838.

Section Filosa LANKESTER, 1885, p. 838 (*partim*).

Section Proteana LANKESTER, 1885, p. 838.

Zoosporeae BERLESE *in* Saccardo, 1888, p. 453 (*partim*).

Azoosporeae BERLESE *in* Saccardo, 1888, p. 453 (*partim*).

Suborder Labyrinthuleae ZOPF, 1892, p. 46.

Subclass Proteomyxés DELAGE & HÉROUARD, 1896, p. 66 [*nom. neg.*].

Subclass Proteomyxiae DELAGE & HÉROUARD, 1896, p. 66.

Order Acystosporés DELAGE & HÉROUARD, 1896, p. 66 (*partim*) [*nom. neg.*].

Order Acystosporidia DELAGE & HÉROUARD 1896, p. 66 (*partim*).

Order Labyrinthulés DELAGE & HÉROUARD, 1896, p. 79 [*nom. neg.*].

Order Zoosporés DELAGE & HÉROUARD, 1896, p. 72 [*nom. neg.*].

Order Zoosporida DELAGE & HÉROUARD, 1896, p. 72.

Order Azoosporés DELAGE & HÉROUARD, 1896, p. 67 [*nom. neg.*].

Order Azoosporida DELAGE & HÉROUARD, 1896, p. 67.

Order Filoplasmodiés DELAGE & HÉROUARD 1896, p. 79 [*nom. neg.*].

Order Filoplasmodida DELAGE & HÉROUARD, 1896, p. 79.

Order Oomycétes VAN TIEGHEM, 1898, p. 22 (*partim*) [*nom. neg.*].

Suborder Protomyxidea DOFLEIN, 1901, p. 40.

Order Vampyrellida WEST, 1901, p. 308, 333.

Order Labyrinthuleae OLIVE, 1902, p. 453.

Order Myxoidea HARTOG *in* Harmer & Shipley, 1906, p. 89.

Order Filoplasmodia CALKINS, 1909, p. 38.

Subclass Proteomyxa CALKINS, 1909, p. 38.

Suborder Reticulosa (Proteomyxa) MINCHIN, 1912, p. 217.

Myxozoa SCHEPOTIEFF, 1912, p. 267 (*partim*).

Mycetozoa SCHEPOTIEFF, 1912, p. 267 (*partim*) [*non* Mycetozoa de Bary, 1859].

Mycetozoida SCHEPOTIEFF, 1912, p. 267 (*partim*) [*non* Mycetozoida Calkins, 1901].

Order Labyrinthulidea POCHE, 1913, p. 194.

Order Vampyrellidea POCHE, 1913, p. 182.

Suborder Filoplasmodinae FERNÁNDEZ GALIANO, 1921, p. 40.

Suborder Filoplasmodinos FERNÁNDEZ GALIANO, 1921, p. 40 [*nom. neg.*].

Order Proteomyxae CHATTON, 1925, p. 76.

Series Hydromyxales E. JAHN *in* Engler & Prantl, 1928, p. 311 (*partim*).

Myxothallophyta FITZPATRICK, 1930, p. 5 (*partim*).

Order Proteomyxa KUDO, 1931, p. 177.

Labyrinthuloidea VALKANOV, 1940, p. 245.

Order Proteomyxida T. L. JAHN & F. F. JAHN, 1949, p. 108.

Order Labyrinthulales MARTIN *in* Ainsworth & Bisby, 1950, p. 411.
Pseudo-Heliozoaires TRÉGOUBOFF *in* Grassé, 1953, p. 466 [*nom. neg.*].
Order Protomyxidea TRÉGOUBOFF *in* Grassé 1953, p. 466.
Order Protomyxées TRÉGOUBOFF *in* Grassé, 1953, p. 466 [*nom. neg.*].

Branching and anastomosing radiating filopodia or rhizopodia; no test or shell; majority parasitic on algae or higher plants in fresh or marine water; flagellate swarmers and encystment occur in life cycle.

Family LABYRINTHULIDAE Cienkowski, 1867

Family Labyrinthulidae DOFLEIN, 1901, p. 47 [*nom. correct. pro* Labyrinthuleae Cienkowski, 1867].
Labyrinthuleae CIENKOWSKI, 1867, p. 274.
Family Labyrinthuleen ZOPF, 1892, p. 46 [*nom. neg.*].
Family Filoplasmodieae HARTOG *in* Harmer & Shipley, 1906, p. x, 90 [*nom. nud.*].
Family Labyrinthulida COPELAND, 1956, p. 201, 203 [*nom. van. pro* family Labyrinthulidae Doflein, 1901].

Small fusiform bodies grouped in a network of filopodia, or pseudoplasmodium, individuals encyst independently, may have flagellate stage in life cycle.

Family PSEUDOSPORIDAE Berlese, 1888

Family Pseudosporidae POCHE, 1913, p. 197 [*nom. correct. pro* family Pseudosporeae Berlese, 1888].
Monadineae Zoosporeae CIENKOWSKI, 1865, p. 213.
Family Pseudosporeen ZOPF, 1885, p. 115 [*nom. neg.*].
Family Pseudosporeae BERLESE *in* Saccardo, 1888, p. 453.
Family Pseudosporinae DELAGE & HÉROUARD, 1896, p. 74 [*nom. correct. pro* family Pseudosporeae Berlese, 1888].
Family Zoosporeae HARTOG *in* Harmer & Shipley, 1909, p. x, 89 [*nom. nud.*].
Family Ectobiellidae POCHE, 1913, p. 199.
Family Pseudosporea COPELAND, 1956, p. 191 [*nom. van. pro* family Pseudosporidae Poche, 1913].

Solitary and heliozoan-like, with flagellate swarmers.

Family VAMPYRELLIDAE Zopf, 1885

Family Vampyrellidae KLEBS, 1892, p. 428 [*nom. correct. pro* family Vampyrellaceae Zopf, 1885].
Monadinae Tetraplastae CIENKOWSKI, 1865, p. 218.
Family Hydromyxaceae KLEIN, 1882, p. 254 [*nom. nud.*].
Family Vampyrellaceae ZOPF, 1885, p. 99.
Family Bursullineen ZOPF, 1885, p. 111 [*nom. neg.*].
Family Bursullineae BERLESE *in* Saccardo, 1888, p. 453.
Family Vampyrellae BERLESE *in* Saccardo, 1888, p. 453 [*nom. correct. pro* family Vampyrellaceae Zopf, 1885].
Family Vampyrellacées VAN TIEGHEM, 1898, p. 22 [*nom. neg.*].
Family Azoosporidae DOFLEIN, 1901, p. 40 [*nom. nud.*].
Family Vampyrellida CASH & HOPKINSON, 1905, p. 36 [*nom. correct. pro* family Vampyrellaceae Zopf, 1885].
Family Azoosporeae HARTOG *in* Harmer & Shipley, 1906, p. x, 89 (*partim*) [*nom. nud.*].
Family Bursullidae POCHE, 1913, p. 183 [*nom. correct. pro* family Bursullineae Berlese, 1888].
Family Monobidiidae POCHE, 1913, p. 183.
Family Pseudo-Heliozoa SANDON, 1927, p. 146 [*nom. nud.*].
Family Plakopodaceae E. JAHN *in* Engler & Prantl, 1928, p. 313.
Family Azoosporida VALKANOV, 1940, p. 240 [*nom. nud.*].
Family Vampyrellacea COPELAND, 1956, p. 191 [*nom. van. pro* family Vampyrellidae Klebs, 1892].

Solitary and heliozoan-like, multinucleate; without flagellate swarmers.

FAMILIES HERE EXCLUDED FROM THE RHIZOPODEA

The following family names were originally described as belonging to the Rhizopodea but have since been excluded. They are listed alphabetically, without regard to present or former systematic position.

Family Asterodiscina EHRENBERG, 1839, table opposite p. 120 (based on *Asterodiscus* Ehrenberg, which is unrecognizable, possibly a discoidal bryozoan).

Family Cadosinidae WANNER, 1941, p. 91 (belongs to Calpionellids).

Family Dactyloporida JONES *in* Griffith & Henfrey, 1875, p. 319(=algae).

Family Dactyloporidea CARPENTER *in* Zittel, 1880, p. 81 [*nom. correct. pro* family Dactyloporida Jones, 1875] (=algae).

Family Dactyloporidae SCHWAGER, 1877, p. 23 [*nom. correct. pro* family Dactyloporida Jones, 1875] (=algae).

Subfamily Dactyloporinae BRADY, 1881, p. 43 [*nom. transl. ex* family Dactyloporidae Carpenter, 1880] (=algae).

Family Frumentaria AGASSIZ, 1844, p. 4 [*nom. correct. pro* family Frumentarina Ehrenberg, 1839] (=algae).

Family Frumentarina EHRENBERG, 1839, table opposite p. 120 (=algae).

Subfamily Girvanellinae RHUMBLER, 1895b, p. 83 (=algae).

Family Ovulitidea REUSS, 1862, p. 364 (=algae).

Family Pithonellidae KELLER, 1946, p. 94 (=calpionellids).

Order Reitlingerellida VOLOGDIN, 1958, p. 405 (includes about 12 genera of Cambrian organisms, regarded originally as Foraminiferida, but not here included as their relationships seem obscure).

Family Stomiosphaeridae WANNER, 1941, p. 92 (=calcareous spheres, perhaps organic, not here included).

Group Testamoebiformia CARTER, 1880, p. 446 (questionable affinities).

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LARGER CRYPTOSTOME BRYOZOA OF THE ORDOVICIAN AND SILURIAN, ANTICOSTI ISLAND, CANADA—PART II

JUNE PHILLIPS ROSS
Illinois State Geological Survey, Urbana

ABSTRACT—Valid species of larger cryptostome Bryozoa of the genera *Phaenopora*, *Stictopora*, and *Pachydictya* in late Ordovician and early and middle Silurian strata of Anticosti Island may be conveniently assigned to three informal categories: *Phaenopora superba* Billings to the escharoporid group; *Stictopora* sp. A to the stictoporid group; and *Pachydictya ambigua* (n. sp.) to the pachydictyid group. Restudy of the original material and additional specimens of the type species of *Phaenopora*, *P. explanata* Hall, indicate its morphological similarity to *Stictoporella*.

Reexamination of the type species of *Hemidictya*, *H. lebanonensis* Coryell, reveals that this genus, like *Rhinidictya*, is a synonym of *Stictopora*.

INTRODUCTION

THIS paper is the second and concluding part of a study of the larger cryptostome Bryozoa species of Anticosti Island. The description of the late Ordovician and early and middle Silurian species of *Ptilodictya* and *Stictoporella*, the distribution, occurrence, and taxonomic groupings of the larger cryptostome bryozoan species appeared earlier (Ross, 1960), as did a map of the island with the place names, the table of stratigraphic distribution, and the discussion of the age of the strata. The following pages contain description of the remaining genera and species.

The species described include: *Phaenopora explanata* Hall, *Phaenopora superba* (Billings), and *Ptilodictya nitidula* Billings of the escharoporid group; *Stictopora lebanonensis* (Coryell), *Stictopora* sp. A., *Stictopora? crassa* Hall, *Stictopora* sp. indet. of the stictoporid group; and *Pachydictya ambigua* n. sp. and *Pachydictya hexagonalis* Ulrich of the pachydictyid group. These three informal taxonomic groups are characterized by colonies in which the zooecia are aligned in longitudinal ranges. The groups are distinguished from each other by distinctive lamellate zooecial wall structures, mode of growth of the zooecium from the mesotheca, and occurrence of mesopores, acanthopores, and transverse structures in the zooecial tubes.

ACKNOWLEDGEMENTS

I am indebted to C. O. Dunbar, Yale University, who suggested the investigation; G. A. Cooper and R. S. Boardman, U. S. National Museum; H. Frebold, P. Harker, and T. Bolton, Geological Survey of Canada; N. Newell, American Museum of Natural History; and T. G. Perry, Indiana University, for the loan of material from various collections. Dr. T. Bolton kindly provided helpful information on the stratigraphy of Anticosti Island. The work was undertaken during the tenure of a post-doctoral research fellowship from Yale University.

ABBREVIATIONS OF REPOSITORIES

AMNH—American Museum of Natural History
GSC—Geological Survey of Canada
USNM—U. S. National Museum
YPM—Yale University, Peabody Museum

SYSTEMATIC PALEONTOLOGY

ESCHAROPORID GROUP

Colonies are bifoliate and have ribbon-shaped or explanate forms of growth. Zooecia are aligned in longitudinal ranges. Mesopores occur in the interspaces (*i.e.* the zooecial walls) separating the zooecial tubes. Acanthopores are absent.

Zooecia grow from the mesotheca at a low angle and form a narrow inner region of thin zooecial walls. The bases of the superior hemisepta mark the beginning of the outer region of thickened zooecial walls. The inner zooecial walls lining the zooecial tubes have laminae steeply inclined distally to the surface of the colony. The laminae of the inner walls pass into the broadly

curved convex intertonguing laminae of the outer walls.

The mesotheca lacks median tubuli.

Genus PHAENOPORA Hall

Phaenopora HALL, 1851, Am. Jour. Sci., ser. 2, v. 11, p. 399; HALL, 1852, Paleontology of New York, N. Y. Nat. Hist. Survey, v. 2, p. 46,47.

Type species (designated by Ulrich, 1890, p. 392).—*Phaenopora explanata* Hall, 1852, Palaeontology of New York, N.Y. Nat. Hist. Survey, v. 2, p. 46, 47, pl. 18, figs. 6a,b,d,e.

Diagnosis.—Colonies are bifoliate and explanate. Zooecia are in longitudinal ranges and two mesopores are regularly placed in the longitudinal interspace between zooecia. These mesopores extend the complete depth of the thickened mature region. Additional mesopores commonly surround the zooecia but they extend only a short distance below the surface of the colonies. Internal structures are poorly known in the type species but superior hemisepta at the base of the thickened mature region are present. Acanthopores and median tubuli are absent.

Remarks.—The type species of *Phaenopora*, *P. explanata* Hall, is poorly preserved in lower Silurian dolomite of the Cataract group. Distinguishing characters for this primary type are based on the external structures as thin sections reveal complete recrystallization of the zooecial walls and obliteration of all skeletal microstructures. A superior hemiseptum however does appear to be present.

The colonies apparently grow from a pointed proximal tip and develop as a slender strap gradually expanding into a broad, frondescent, explanate growth having numerous gentle folds and undulations. The colonies when mature may have considerable surficial extent but they are invariably fragmented. In coarse, well sorted calcarenite the zoarial fragments are usually 1–2 cm. square.

Maculae consisting of flat aggregations of mesopores when present in a colony are commonly arranged in the longitudinal ranges. Monticules consisting of elevated zooecia and clusters of zooecia are regularly spaced over the zoarial surfaces.

The genus is found in the Silurian of the United States, Canada (Bassler, 1928), Gotland (Hennig, 1905), and the Siberian platform of Russia (Schoenmann, 1927, Astrova, 1955, Nikiforova, 1955). Recent Russian references appear to restrict *Phaenopora* to the Silurian (Astrova, 1955) although Ordovician species are recorded by Nikiforova (1955). Ulrich (1893) records

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EXPLANATION OF PLATE 41

FIGS. *1–4,6–9*—*Phaenopora superba* (Billings). *1*, Shallow tangential section cut through a monticule with mesopores at its apex and cut across regularly arranged zooecia and mesopores, USNM 143031, West Becscie River cliff, Becscie formation. ×5. *2*, Surface of a broad explanate colony with elevated monticules, USNM 143032, Wreck Beach, Becscie formation. ×2. *3*, Portion of a transverse section showing the mesotheca and zooecia along each side of it, USNM 143032, Wreck Beach, Becscie formation. ×50. *4*, Deep tangential section cut through a monticule with large mesopores and zooecia of variable size. Note the inner walls of the zooecia are commonly lined with denticles. USNM 143031, West Becscie River Cliff, Becscie formation. ×50. *6*, Portion of a longitudinal section showing zooecia growing from the slender mesotheca. A superior hemiseptum lies at the base of the thickened laminate zooecial walls. USNM 143032, Wreck Beach, Becscie formation. ×50. *7*, Shallow tangential section cut through a monticule having abundant mesopores between zooecia, USNM 143033, West Becscie River cliff, Becscie formation. ×50. *8*, Shallow tangential section through a monticule. Thick skeletal walls separate rows of mesopores. Note the fine pustulous structure in the zooecial walls. USNM 143033, West Becscie River cliffs, Becscie formation. ×50. *9*, Deep tangential section of the holotype showing numerous mesopores between zooecia, GSC 2352, Wall Cove, Becscie formation. ×50.

5—*Phaenopora explanata* Hall. External view of the colony having zooecia and mesopores in well defined ranges. AMNH 1490, Flamborough Head, Ontario, Canada, Cataract group. ×2.

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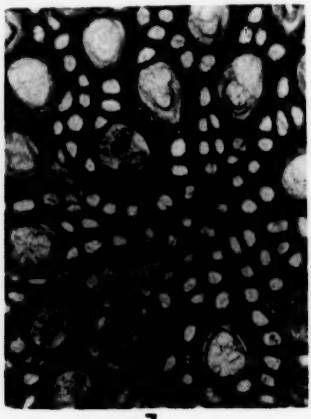

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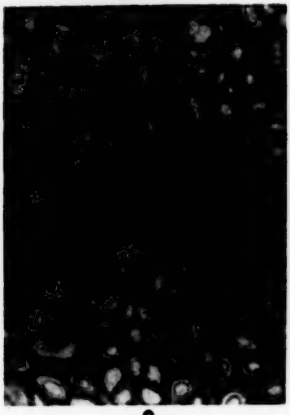

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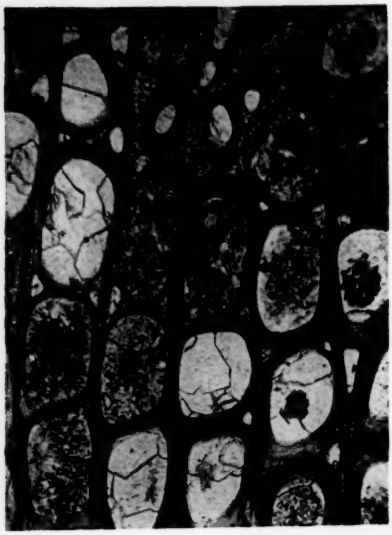

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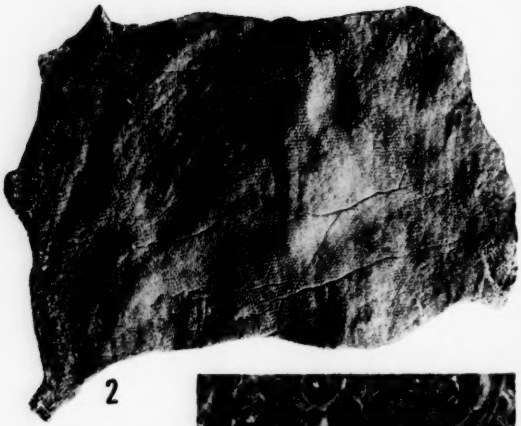

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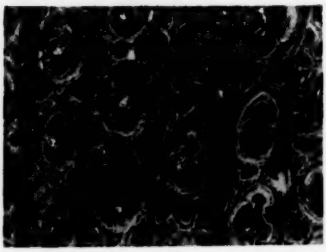

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Phaenopora wilmingtonensis from the Upper Ordovician, Wilmington, Illinois, but this species has not been investigated in the present study.

Yang (1957) records a new bifoliate genus, *Trepocryptopora*, from the Ordovician of Liangshan, Southern Shensi. The illustrations of the two new species of this genus show numerous mesopores between zooecia and a simple mesotheca without median tubuli and these structures suggest affinities of these species with *Phaenopora*. However the presence of tabulate zooecia with overlapping diaphragms appears to distinguish this new genus from *Phaenopora*.

PHAENOPORA EXPLANATA Hall 1852
Pl. 41, fig. 5

Phaenopora explanata HALL, 1852, New York Nat. Hist. Survey, Palaeontology of New York, v. 2, p. 46, pl. 18, figs. 6a,6b,6d,6e.

Type material.—AMNH 1490. This block of dolomite contains Hall's syntypes figured on pl. 18, figs. 6a,b,d,e, 1852. This material was collected from Flamborough Head, Ontario, Canada, but its exact placement in the Cataract group of the Silurian is not known.

Additional material.—Three blocks of dolomite with 10 zoarial fragments were examined from the U. S. National Museum, no. 56108. This material comes from Hamilton, Ontario, Canada, but its exact placement in the upper part of the Cataract group of the Silurian is not known.

Description.—The broad explanate colonies show no branching. The flat zoarial surfaces exhibit a series of longitudinal ranges within which zooecia and mesopores are regularly spaced. Two mesopores are present in the longitudinal interspaces between successive zooecia in any range. The zooecia lack prominent rims at the surface. The thick zooecial walls of the lateral interspaces lack mesopores and acanthopores. New zooecia appear to develop in the median region of the colony by subdivision of a preceding zooecium and the commencement of an additional longitudinal range. The colonies have very narrow lateral margins having no zooecia but the margins are rarely observed in the fragmented and abraded specimens.

A transverse section of the lectotype shows recrystallized coarse, calcite and dolomite grains with interlocking texture. The zooecial tubes can be distinguished with difficulty but no skeletal microstructures are preserved. The bilaminate structure of the mesotheca has likewise been obliterated.

Remarks.—The problem of studying the poorly preserved type material of *Phaenopora explanata* was discussed by Ross (1960, p. 1072). At that time it was noted that

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EXPLANATION OF PLATE 42

FIGS. *1–7*—*Phaenopora superba* (Billings). *1*, Shallow tangential section through longitudinal ranges of zooecia. Mesopores are abundant in the monticule and are located between zooecia, Some zooecial walls show fine pustulous microstructure. USNM 143032, Wreck Beach, Becscie formation. ×50. *2*, View of the holotype across the mesotheca GSC 2352, Wall Cove, Becscie formation. ×2. *3*, General aspect of the colony growing from a slender strap and expanding as a broad explanate sheet, YPM 20472, St. Mary Cliff no. 3, Gun River formation. ×1. *4*, Shallow tangential section showing longitudinal ranges of zooecia and mesopores. Inner zooecial walls are lined with denticles, USNM 143034, near Long Point, Becscie formation. ×50. *5*, Portion of a transverse section showing thickened laminate zooecial walls in the mature region. The denticles lining the inner zooecial walls are in part hollow. UNSM 143035, West Becscie River cliff, Becscie formation. ×100. *6*, Very deep tangential section showing typical aspect of the zooecial tubes in longitudinal ranges. The section lies almost below the zone of mesopores and near the base of the mature region. YPM 20471, St. Mary Cliff no. 3, Gun River formation. ×50. *7*, Portion of a transverse section showing the hollow parts of denticles in the zooecial walls. Laminae of a diaphragm crossing the zooecial tube pass into the laminae lining the inner zooecial walls. USNM 143031, West Becscie River Cliff, Becscie formation. ×100.

TABLE 1—MEASUREMENTS OF *Phaenopora explanata* LECTOTYPE AMNH 1490, in millimeters

Zoarial length	35
Zoarial width	25
Zoarial depth	7
No. of zooecia/2 mm.	
Longitudinally	7– 9
Laterally	9–11
Interspace	
Longitudinally	0.06–0.10
Laterally	0.10–0.12
Zooecial diameter	(0.18–0.16) ×(0.08–0.06)
Diameter of mesopores	approx. 0.01

Phaenopora and *Stictoporella* may be congeneric. However both genera were retained as distinct until extensive geographical studies of these bryozoans had been undertaken.

PHAENOPORA SUPERBA (Billings)

Pl. 41, figs. 1–4, 6–9; pl. 42, figs. 1–7

Ptilodictya superba BILLINGS, 1866, Catalogue of the Silurian fossils of the Island of Anticosti, p. 35.

Phaenopora superba (Billings), BASSLER, *in* Twenhofel, 1928, Geology of Anticosti Island, Canada Geol. Survey, Mem. 154, p. 164, pl. 9, figs. 10,11; pl. 11, figs. 6–9.

Phaenopora twenhofeli BASSLER, *in* Twenhofel, 1928, *ibid.*, Mem. 154, p. 164, pl. 7, figs. 14,15, pl. 11, figs. 3,4.

Type material.—Holotype GSC 2352. Collected by T. C. Weston, 1865, from Wall's Cove, Anticosti; Becscie formation; Silurian.

Additional material.—About 40 zoarial fragments from Silurian rocks, Anticosti Island.

Description.—Broad explanate colonies grow from pointed proximal tips. Monticules consist of elevated clusters of zooecia and mesopores (Pl. 41, fig. 2). Zooecia are regularly arranged in longitudinal ranges between monticules.

The large zoarial fragment of the holotype, GSC 2352, is split across the mesotheca and displays curved growth bands across the colony (Pl. 42, fig. 2).

Zooecia initially grow from the mesotheca making a low angle with it. The long zooecial tubes and zooecial walls form two distinct zones: a narrow inner zone with thin zooecial walls between the mesothecal plane and hemisepta and a wide outer zone with greatly thickened zooecial walls between the inferior and superior hemisepta and the surface of the colony. Inferior hemisepta project from the mesotheca and well developed superior hemisepta project into the zooecial tubes above the inferior hemisepta (Pl. 41, fig. 6). In a deep tangential section the superior and inferior hemisepta appear as two prongs projecting from opposite zooecial walls into a zooecial tube. The thickened walls of the outer zone consist of an inner wall and an outer wall. The inner wall consists of steeply inclined laminae which extend distally into the outer wall. The outer wall is composed of intertonguing broadly curved, distally convex laminae between two inner walls. In longitudinal, transverse, and tangential sections the convex laminae of the outer wall commonly appear as a dense median zone lined by two laminate inner walls (Pl. 42, fig. 5). Walls lining the mesopores have a similar microstructure. In shallow tangential sections a fine pustulous pattern may be present in the zooecial walls (Pl. 42, fig. 1).

Many specimens show denticulate inner walls consisting of hollow spines located in the laminae of the inner walls and projecting into the zooecial tubes (Pl. 41, figs. 4,7; Pl. 42, figs. 4,5,7). Mesopore walls lack this denticulate structure. In tangential sections which pass through denticles the zooecial tubes are infilled with perforate laminae of the inner wall (Pl. 42, fig. 4).

Zooecia grow in well defined longitudinal ranges. In shallow tangential sections this pattern may be obscured by abundant mesopores between zooecia. However in deep tangential section (Pl. 42, fig. 6) the arrangement of the zooecia is clearly seen. In shallow tangential section the zooecial tubes have variable outline but in deep tangential section the triangular outline is distinctive.

Mesopores of variable size and outline are generally located in the longitudinal interspace between zooecia. In deep tangential section near the base of the thickened zooecial walls, commonly only two mesopores occur in the longitudinal interspace. In shallow tangential sections many additional mesopores are present in the zooecial walls.

TABLE 2—MEASUREMENTS OF *Phaenopora superba* (in millimeters)

Measurements	Holotype GSC 2352	GSC 15100	USNM 143032	USNM 69035-2	YPM 20817
Zoarial branch depth	not det.	1.1–2.0	1.2	1.3–1.4	1.0–1.1
No. of zooecia/2 mm. Longitudinally Laterally	 not det. not det.	 7 9½–10	 6 8	 av. 6½ av. 8	 8 8
Longitudinal interspace Lateral interspace	0.02 0.02	.01–.04 .04–.08	.03–.09 .04–.07	.04–.06 .06–.10	.05–.08 .04–.06
Diameter of zooecia at zoarial surface	(.20–.23) ×(.13–.14)	(.07–.09) ×(.10–.12)	(.22–.38) ×(.14–.20)	(.06–.12) ×(.10–.14)	(.14–.18) ×(.14–.18)
Diameter of zooecia at zoarial surface in monticules	(.23–.24) ×(.16–.20)	not det.	not det.	not det.	not det.
Ratio: Width of zooecium in mature region / Width of zooecium	not det.	0.88	0.75–0.86	not det.	0.83–0.86
Mesopores/zooecium at zoarial surface	7–10	6–8	2–4	3–6	5–8
Diameter of mesopores	(.08–.14) ×(.03–.09)	(0.02–0.04) ×(0.02–0.06)	(.02–.06) ×(.02–.08)	(.02–.04) ×(.02–.04)	(.02–.04) ×(.02–.06)
Depth of zooecia in mesotheca	not det.	0.02	0.02	0.02	0.04
Diameter of mesopores in monticules	(.05–.08) ×(.04–.08)	not det.	not det.	not det.	not det.

The simple mesotheca is composed of overlapping basal zooecial walls and lacks median tubuli.

Occurrence.—Becscie formation:

Zone 1. USNM cat. no. 143034, GSC 7414.

Zone 2. YPM coll. no. 3063/72.

Zone 3. YPM coll. no. 3063/68, GSC 2352, GSC locality no. 7417, USNM cat. no. 69036, GSC 15100.

Zone 4. YMP coll. nos. 3063/66, 3063 /101, GSC locality no. 7425, GSC locality no. 7426, USNM cat. no. 143033, 69035.

Gun River formation:

Zone 3. YPM coll. no. 3063/104—YPM cat. nos. 20471, 20472, 20817.

Age.—Early to middle Silurian.

Remarks.—A wide range in the measurements of zooecia, zooecial walls, mesopores etc. is observed when different areas of a colony are examined. If this is taken into consideration *Phaenopora twenhofeli* Bassler 1928 from Anticosti Island is found to be conspecific with *P. superba* as its zoarial characters lie within the range of *P. superba*.

Little is known of the distribution of the species of *Phaenopora* in North America. Early species referred to this genus require individual assessment and revision. *P. superba* appears to have some affinities with the upper Ordovician species, *P. wilmingtonensis* Ulrich, from Wilmington, Illinois, but the latter species is in need of redescription.

This latter species has similar zooecial features but the zooecia appear considerably larger. Of other species, specimens of *Phaenopora lindstromi* Ulrich (1890) de-

scribed by Henning (1905, p. 10–16) from the Silurian of Gotland have similar morphological features. In the Scandinavian material inferior and superior hemisepta are well developed but few mesopores appear to be present.

Fragmented colonies of *Phaenopora superba* are very abundant in the samples from the Becscie formation, and at St. Mary's cliff in the Gun River formation. They occur in a well sorted siliceous calcarenite in which other fossils are not abundant. The colonies lie parallel to the bedding and are associated with brachiopods.

Genus PTILODICTYA Lonsdale
PTILODICTYA NITIDULA Billings
Pl. 43, fig. 6

Ptilodictya nitidula BILLINGS, 1866, Catalogue of the Silurian fossils of the Island of Anticosti, p. 9.
Rhinidictya nitidula (Billings) BASSLER, *in* Twenhofel, 1928, Geology of Anticosti Island, Canada Geol. Survey Mem. 154, p. 165, pl. 14, figs. 14,15.

Type material.—Holotype GSC 2004. Collected by James Richardson, Salmon River, Anticosti Island.

Remarks.—The type specimen is too small a fragment for sectioning if part is to be retained as a handspecimen. The very slender ribbon-shaped strap has zooecia in longitudinal ranges and very narrow lateral margins without zooecia.

Until additional material becomes available for study this species is not recognizable.

STICTOPORID GROUP

Colonies are bifoliate and have a ribbon-shaped form of growth. Zooecia are aligned in longitudinal ranges. Acanthopores are abundant in the zooecial walls. Mesopores are absent.

Zooecia grow from the mesotheca at a low angle and form a narrow inner region of thin zooecial walls. The base of the superior hemisepta marks the beginning of the outer region of thickened zooecial walls. The inner zooecial walls lining the zooecial tubes have laminae steeply inclined distally to the surface of the colony. The laminae of the inner walls pass into the broadly curved convex intertonguing laminae of the outer walls.

The mesotheca is pierced by median tubuli.

Genus STICTOPORA Hall

Stictopora HALL, 1847, Palaeontology of New York, v. 1, p. 73; PHILLIPS, 1960a, Palaeontology, v. 3, p. 7.
Sulcopora D'ORBIGNY, 1849, Revue et Magasin de Zoologie, v. 1, p. 499.
Rhinidictya ULRICH, 1882, Jour. Cincinnati Soc. Nat. Hist., v. 5, p. 152.
Hemidictya CORYELL, 1921, Indiana Acad. Sci., Proc. for 1919, p. 303.

Type species.—*Stictopora fenestrata* Hall (1847, p. 16) designated by Ulrich (1886, p. 67).

Remarks.—Thin sections cut by Coryell from the holotype of *Hemidictya lebanonensis* Coryell, type species of *Hemidictya*, reveal similar skeletal microstructures to those found in species of *Stictopora* Hall (1847), and *Hemidictya* is congeneric with *Stictopora*.

STICTOPORA LEBANONENSIS (Coryell)
Pl. 43, figs. 1,4,7

Hemidictya lebanonensis CORYELL, 1921, Indiana Acad. Sci., Proc. for 1919, p. 303,304, pl. 14, figs. 1–3.

Type material.—Indiana University Paleontology Collections 248/25; Big Springs, Rutherford County, Tennessee; Lebanon formation, middle Ordovician. The handspecimen has not been located.

Remarks.—The thick longitudinal section cut from a deeply weathered specimen shows inferior and superior hemisepta projecting into the zooecial tubes (Pl. 43, fig. 4). The microstructure of the laminate zooecial walls is not clearly displayed.

A tangential section of the narrow bifoliate bifurcate branch shows numerous acanthopores in the zooecial walls and the zooecia, oval in cross section, are arranged in longitudinal ranges. The inner and outer parts of the laminate zooecial walls are well defined. In transverse section numerous median tubuli pierce the mesotheca.

STICTOPORA sp. A
Pl. 43, figs. 2,3,9

Material.—Three zoarial fragments in the Ordovician rocks, Anticosti Island.

Description.—Colonies are slender, bifurcate ribbon-shaped branches with lobate, frilled lateral margins (Pl. 43, fig. 9). These broad lateral margins lack zooecia but contain abundant acanthopores. Zooecia are arranged in median longitudinal ranges.

TABLE 3—MEASUREMENTS OF *Stictopora lebanonensis* (CORYELL), INDIANA UNIV. PALEONT. COLL. 248/25, (in millimeters)

Zoarial branch length	not det.
Zoarial branch width	1.8 incomplete
Zoarial branch depth	1.1
Ranges on branch	10 incomplete
No. of zooecia/2 mm.	
Longitudinally	5 –6.5
Laterally	7.5–8
Longitudinal interspace	0.10–0.24
Lateral interspace	0.08–0.12
Diameter of zooecia at surface of colony	(0.12–0.18) ×(0.06–0.10)
Depth of zooecia in mesotheca	0.03

Zooecia grow from the mesotheca at a low angle and form an inner zone of thin zooecial walls. The outer zone of thickened zooecial walls shows laminate microstructure as observed in the type species of *Stictopora*. Superior and inferior hemisepta are well developed. Median tubuli were not observed in the oblique longitudinal section and no transverse sections could be obtained. A single series of acanthopores in the zooecial walls surround the zooecial tubes.

Occurrence.—Vaureal formation:

Zone 3–4. YPM (Twenhofel 32)—YPM cat. no. 21180.

Ellis Bay formation:

Zone 2. YPM coll, no. 3063/34—YPM cat. no. 21179.

Age.—Late Ordovician.

Remarks.—Adequate description of this species will have to await additional collections. It is difficult to compare this species with previously described species of *Stictopora* but the frilled lateral margins having numerous acanthopores may be distinctive.

STICTOPORA? CRASSA Hall

Pl. 43, figs. 5,8

Stictopora crassa HALL, 1852, Palaeontology of New York, v. 2, p. 45, pl. 18, figs. 4a–c; WHITFIELD & HOVEY, 1899, Am. Mus. Nat. Hist., Bull. 11, pt. 1, p. 108.

Type material.—Two syntypes AMNH 1502. Flamborough Head, Ontario, Canada; Cataract group, Silurian.

Remarks.—This species is poorly preserved in Silurian dolomite and thin section study does not reveal any skeletal microstructures as the specimens have been completely recrystallized. The surface of the colony shows zooecial tubes with oval cross section aligned in longitudinal ranges. This species is not recognizable until better preserved material becomes available for study.

Following Ulrich's assignment of the species *Pachydictya crassa* in 1893, many zoarial fragments from the Ordovician and Silurian of Canada, New York State, Ohio, Indiana, Kentucky, and Tennessee have been referred to this species as *Pachydictya crassa*. The taxonomic position of these specimens require restudy and individual reassessment.

STICTOPORA sp. indet.

This heading refers to a slender, bifoliate, straplike colony, YPM 21178, from the English Head formation, Carleton Point, Anticosti Island.

A tangential section of the colony shows a well developed series of acanthopores in the zooecial walls between zooecia which are oval in cross section. The zooecia are arranged in longitudinal ranges. In longitudinal section the zooecia have a broad inner zone of thin walls which pass into the outer zone of thickened zooecial walls. Superior hemisepta were not observed. The simple mesotheca contains median tubuli.

Occurrence.—English Head formation: zone 4, YPM 3063/21—YPM cat. no. 21178.

Age.—Late Ordovician.

Remarks.—Insufficient data do not permit comparison of the species.

PACHYDICTYID GROUP

Colonies are bifoliate and have ribbon-shaped and explanate forms of growth. Zooecia are aligned in longitudinal ranges. Tabulate interspaces occur near the base of the outer region of thickened zooecial walls and extend for some distance into the outer region. Acanthopores are numerous.

Zooecia grow from the mesothecal plane at a low angle and form an inner zone having thin zooecial walls. The gradual deflection

TABLE 4—MEASUREMENTS OF *Stictopora* SP. A (in millimeters)

Measurements	YPM 21179	YPM 21180
Zoarial branch length	10	6.5
Zoarial branch width	2.2–2.6	4.0
Zoarial branch depth	.70	not det.
Ranges on branch	7	15 minimum
No. of zooecia/2 mm. Longitudinally distally median	6.5	7.5
lateral	6	not det.
Laterally distally median	13	12
lateral	9	not det.
Longitudinal interspace Median	.02	not det.
Lateral	.03 minimum	not det.
Lateral interspace Median	.02	not det.
Lateral	.02–.04	not det.
Diameter of zooecia at surface of colony Median	(.28–.30) ×(.10–.13)	(.18–.22) ×(.10–.13)
Lateral	(.20–.44) ×(.10–.12)	(.18–.25) ×(.12–.20)
Depth of zooecia in mesotheca	.02–.03	not det.
Acanthopores/zooecium	19–22	not det.

of the zooecia away from the mesotheca where the tabulate interspaces generally first appear marks the beginning of the outer zone of thickened zooecial walls. The inner zooecial walls lining the zooecial tubes are composed of exceptionally long laminae aligned parallel to the direction of zooecial growth. They curve into the broadly arched intertonguing laminae of the outer walls. Hemisepta are absent in the zooecial walls.

The mesotheca is pierced by numerous median tubuli.

PACHYDICTYA Ulrich

Pachydictya ULRICH, 1882, Jour. Cincinnati Soc. Nat. Hist., v. 5, p. 152.

Type species.—*Pachydictya robusta* Ulrich, 1882, Jour. Cincinnati Soc. Nat. Hist., v. 5, p. 173, pl. 8, figs. 10a–C.

Emended definition.—Colonies are bifoliate and have ribbon-shaped or explanate forms of growth. Zooecia at the surface of the colonies are aligned in longitudinal ranges which are not clearly demarcated by raised zooecial walls of the lateral interspaces. Zooecia at the surface are oval in cross section and the zooecial tubes are outlined by circular or oval rims. Acanthopores are numerous in the zooecial walls. Mesopores are absent.

Zooecia grow from the mesotheca at a low angle and form an inner zone having

TABLE 5—MEASUREMENTS OF *Stictopora* SP. INDET. (in millimeters)

Measurements	YPM 21178
Zoarial branch length	20
Zoarial branch width	3.5 minimum
Zoarial branch depth	.11–.16
Ranges on branch	19 minimum
No. of zooecia/2 mm. Longitudinally	4.5–5.0
Laterally	10–11
Longitudinal interspace	.08–.15
Lateral interspace	.05–.12
Diameter of zooecia at surface of colony	(.28–.31) ×(.10–.14)
Depth of zooecia in mesotheca	.02–.03
Acanthopores/zooecium	14–18

thin zooecial walls. The gradual deflection of the zooecia away from the mesotheca where the tabulate interspaces generally first appear marks the beginning of the outer zone of thickened zooecial walls. The inner zooecial walls lining the zooecial tubes are composed of exceptionally long laminae aligned parallel to the direction of zooecial growth. They curve into the broadly arched intertonguing laminae of the outer walls. The numerous acanthopores which multiply in the outer zone commonly obscure the laminate structure of the outer zooecial walls in which no zooecial boundaries are apparent. Hemisepta are absent in the zooecial walls.

The tabulate interspaces first appear in the outer part of the inner zone and commonly extend for some distance into the outer zone.

The simple mesotheca contains numerous median tubuli.

Remarks.—The tabulate interspaces which develop near the base of the outer region of the zooecia and which extend for some distance before they are closed by thickened zooecial walls are a distinctive feature of the genus *Pachydictya*. As the walls of these tabulate interspaces are for the greater part narrow they occasionally appear as if they are a series of overlapping cystiphragms along the zooecial walls.

Pachydictya ambigua n. sp. which is abundant in part of the Anticosti Island sequence and which was previously identified as *P. crassa* is a less robust species than the type species, *P. robusta*. In the present study, species of *Pachydictya* such as *P. hexagonalis* and *P. firma* which have previously been reported from Anticosti Island have not been observed in the collections.

PACHYDICTYA AMBIGUA Ross, n. sp.
Pl. 44, figs. 1–6; pl. 45, figs. 6,9

Type material.–Holotype YPM 20811. Collected by W.H. Twenhofel from the west side of Ellis Bay; Ellis Bay formation; Ordovician.

Additional material.—90 zoarial fragments from various localities in the Ordovician and Silurian of Anticosti Island.

Description.—Colonies are slender bifoliate ribbon-shaped branches with numerous bifurcations (Pl. 45, figs. 6,9). Monticules or maculae are absent. Zooecia are arranged in longitudinal ranges but prominent interspaces or ridges do not demarcate the ranges as in species of *Ptilodictya*. Zooecia leave the mesothecal plane at a low angle, but in oblique longitudinal sections this feature is not readily observed (Pl. 44, fig. 1). The narrow inner zone of thin zooecial walls is replaced by a wide outer zone of thickened zooecial walls. This outer zone develops as the zooecial walls flex towards a horizontal attitude. Narrow tabulate interspaces are poorly developed between the zooecial walls and in many transverse and longitudinal sections they may appear to be lacking. The thickened zooecial walls have a fine granulous microstructure which is crowded with long acanthopores (Pl. 44. figs. 1,2,3).

The laminate microstructure of the thickened zooecial walls which is clearly exhibited in the type species, *Pachydictya robusta*, is obscured by crowding of the zooecial walls with numerous acanthopores. The inner zooecial walls lining the zooecial tubes are composed of exceptionally long laminae aligned parallel to the direction of zooecial growth. These laminae curve into the

TABLE 6—MEASUREMENTS OF *Pachydictya ambigua* N. SP. (in millimeters)

Measurements	Holotype YPM 20811	YPM 20812	YPM 20824	YPM 20825	YPM 21176	YPM 21177
Zoarial branch length	not det.	11	not det.	not det.	not det.	6.3
Zoarial branch width	2.2–2.4	2.5–2.8	2.8–3.0	2.6	2.6	2.0–2.1
Zoarial branch depth	.44–.85	.96	1.6–1.8	1.26	.74–.86	1.1
Ranges on branch	7	6	8–9	6–8	9–10	7
No. of zooecia/2 mm. Longitudinally	5	3–3.5	4.5	4.5–5	4.5–5.0	4.5
Laterally	6–6.5	6	5.5–6.0	6–6.5	6.5–7.0	3.5
Longitudinal interspace	.18–.22	.20–.24	.16–.22	.16–.20	.18–.26	.08–.16
Lateral interspace	.20–.24	.20–.26	.16–.22	.18–.24	.15–.20	.10–.16
Diameter of zooecia at surface of colony	(.20–.24) ×(.10–.12)	(.38–.42) ×(.18–.20)	(.22–.26) ×(.14–.16)	(.18–.22) ×(.08–.10)	(.22–.24) ×(.10–.12)	(.26–.30) ×(.16–.20)
Depth of zooecia in mesotheca	.03	.02	.03–.04	.04	.02	.06

broadly arched intertonguing laminae of the outer zooecial walls.

The very narrow tabulate interspaces, extending possibly one-half the width of the outer zone, do not inflect the zooecial walls. The upper part of the interspaces is closed by considerable thickening of the zooecial walls. Diaphragms are rare in the zooecial tubes.

Shallow tangential sections show oval zooecia in cross section and zooecial walls having abundant well defined acanthopores (Pl. 44, fig. 5). The walls have narrow inner regions and slightly wider outer regions. In deep tangential section the zooecial walls are narrower and the acanthopores when cut obliquely appear as incomplete tubes or rods. (Pl. 44, fig. 6). In very deep tangential section near the top of the inner zone the narrow interspaces between the zooecial walls are observed (Pl. 44, fig. 4).

The mesotheca has abundant median tubuli (Pl. 44, figs. 2,4).

In a longitudinal section of YPM 20810 (Pl. 44, fig. 1) a cluster of vesicular structures near the surface of the colony disrupts the regular microstructure of the zooecial walls.

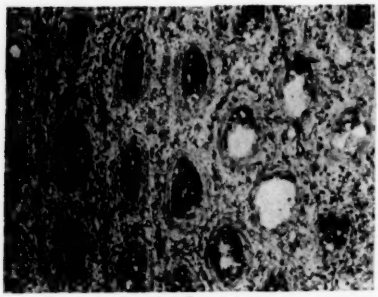
EXPLANATION OF PLATE 43

FIGS. *1,4,7*—*Stictopora lebanonensis* (Coryell). Sections cut from the holotype by Coryell, Indiana University Paleontological Collection 248/25. Big Springs, Rutherford County, Tennessee. Lebanon limestone, middle Ordovician, all ×50. *1*, Shallow tangential section showing abundant acanthopores in a single series in the zooecial walls. *4*, Longitudinal section through zooecial walls. Note superior hemisepta at the base of the thickened zooecial walls and inferior hemisepta projecting from the mesotheca. *7*, Portion of a transverse section showing median tubuli in the mesotheca.

2,3,9—*Stictopora* sp. A. *2*, Oblique longitudinal section showing broadly curved laminate zooecial walls and simple mesotheca. YPM 21179, cliff one-half mile east of Junction Cliff, Ellis Bay formation. ×50. *3*, Oblique tangential section showing, on the right, abundant acanthopores in the zooecial walls and, on the left, at a deeper level in the colony slender zooecial walls. YPM 21179, cliff one-half mile east of Junction Cliff, Ellis Bay formation. ×50. *9*, External view of a colony with frilled lateral margins which carry numerous acanthopores and no zooecia. YPM 20400, cliff one-half mile east of Junction Cliff, Ellis Bay formation. ×10.

5,8—*Stictopora? crassa* Hall. External view of the syntypes located on the same slab. AMNH 1502, Flamborough Head, Ontario, Canada, Cataract group. ×5.

6—*Ptilodictya nitidula* Billings. External view of the holotype. GSC 2004, Salmon River, exact locality not known. ×2.



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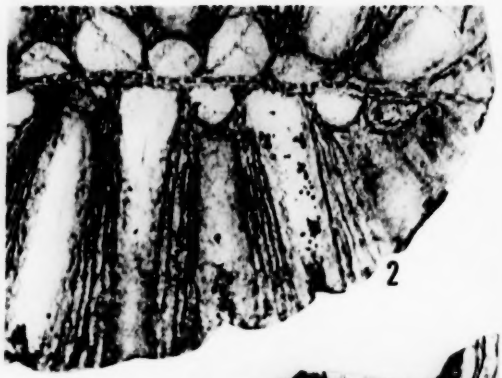

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Occurrence.—English Head formation:

Zone 4. GSC 2256, USNM cat. no. 93582.

Vaureal formation:

Zone 3–4. YPM coll. no. 3063/31.

Ellis Bay formation:

Zone 2. YPM coll. no. 3019/57—YPM cat. nos. 20810, 20811, 20816, 20824, 20825, 21176.

Zone 6. YPM coll. no. 3063/56.

Zone 7. YPM (Twenhofel 40).

Zone 9. USNM cat. no. 69078.

Zone 10. YPM coll. no. 3063/58—YPM cat. no. 20813.

Becscie formation:

Zone 1. USNM cat. no. 55127, YPM coll. no. 3063/62—YPM cat. nos. 20814, 20815.

Jupiter formation:

Zone 4. USNM cat. no. 69103.

Zone 9. YPM (Twenhofel 53).

Chicotte formation:

Zone 1. YPM coll. no. 3063/125—YPM cat. no. 20812.

Age.—Late Ordovician to middle Silurian.

Remarks.—*Pachydictya ambigua* is similar in its form of growth to the type species, *P. robusta*. It has a smaller zoarial branch depth, narrower longitudinal interspaces, and a smaller zooecial diameter than *P. robusta*. Specimens of *P. ambigua* from Anticosti Island were previously identified as *P. crassa*. The poorly preserved type material of this latter species suggests that it belongs to *Stictopora*.

This species is abundant in the Ellis Bay formation (Richmond) but ranges through the Anticosti Island sequence into the Chicotte formation. It is associated with trilobites, brachiopods, trepostomes, *Nematopora* sp., and *Helopora* sp.

The specific name *ambigua* (Latin meaning doubtful or changeable) refers to the changeable microstructures as observed in a number of differently oriented thin sections.

PACHYDICTYA HEXAGONALIS Ulrich
Pl. 45, figs. 1–5,7,8

Pachydictya hexagonalis ULRICH, 1889, Contr. to the Micro-palaeontology of the Cambro-Silurian rocks of Canada, pt. 2, p. 42,43, pl. 9, figs. 2–2c.

Type material.—Holotype GSC 13695 (not sectioned) and a fragment broken from it, USNM 143047 (sectioned). Collected by T. C. Weston, 1884, from Stony Mountain, Manitoba, Canada; Stony Mountain formation; upper Ordovician.

Additional material.—Three zoarial fragments from Stony Mountain, Manitoba, Canada, GSC 6828, a,b, collected by J. B. Tyrell, 1897.

Description.—Colonies are bifoliate and probably explanate. The structure of the early proximal part of the colonies is not known as the material available consists of small fragments about 1 to 2 cm. square. On the outer surface of colonies the hexagon-shaped zooecia are not arranged in a regular pattern and they lie between monti-

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EXPLANATION OF PLATE 44

FIGS. *1–6*—*Pachydictya ambigua* Ross, n. sp. *1*, Portion of an oblique longitudinal section showing well defined acanthopores extending through the zooecial walls. Note the abundant vesicular structures in the small area near the periphery of the colony. YPM 20810, west side of Ellis Bay, Ellis Bay formation. ×50. *2*, Portion of a transverse section showing median tubuli in the mesotheca and acanthopores extending through the zooecial walls. YPM 20811, west side of Ellis Bay, Ellis Bay formation. ×50. *3*, Portion of a transverse section of zoarium with elliptical outline. YPM 20812, upper part of Jumpers, Chicotte formation. ×50. Deep oblique tangential section cutting across the mesotheca. Note the abundant median tubuli extending into the zooecial walls and small irregular space between zooecia. YPM 20813, lower zone of Cape Henry, Ellis Bay formation. ×50. *5*, Shallow tangential section showing zooecial walls with a single series of acanthopores. YPM 20814, west side of Fox Bay, Becscie formation. ×50. *6*, Deep oblique tangential section cut obliquely across acanthopores which appear as a median band in the zooecial walls. YPM 20815, west side of Fox Bay, Becscie formation. ×50.

cules, consisting of slightly elevated clusters of thickened zooecial walls and enlarged zooecia (Pl. 45, fig. 4).

Zooecia grow from the mesothecal plane at a low angle and form an inner zone of thin zooecial walls and lack diaphragms. The gradual deflection of the zooecia away from the mesotheca where the tabulate interspaces first appear marks the beginning of the outer zone of thickened zooecial walls (Pl. 45, figs. 2,3,5,7). Unlike species of *Ptilodictya*, *Phaenopora*, and *Stictopora*, hemisepta are not present in the zooecial walls and the thickened zooecial walls in the outer zone lack the laminate microstructure observed in species of these genera. The zooecial walls have a fine granulous microstructure which is pierced by long acanthopores (Pl. 45, fig. 5). Tabulate interspaces extending two-thirds the width of the outer zone lie between zooecial walls which are inflected by the diaphragms as they pass into them (Pl. 45, figs. 5,7). The upper part of the tabulate interspaces is closed by considerable thickening of the zooecial walls which fills the voids which would otherwise be occupied by these interspaces. Complete and incomplete diaphragms lie across the zooecial tubes and occur towards the periphery. Complete diaphragms generally lie flat but may be flexed near the inner zooecial walls (Pl. 45, fig. 5). Incomplete diaphragms are straight and inclined so that they abut onto underlying complete diaphragms.

Shallow tangential sections show oval to round zooecia in cross section and wide zooecial walls having numerous acanthopores (Pl. 45, fig. 1). The zooecial walls have narrow inner walls and wider outer walls, the acanthopores being most abundant in the latter. In deep tangential sections the acanthopores are located in the inner zooecial walls and are generally cut obliquely so that they appear as incomplete tubes or rods around the zooecial tubes (Pl. 45, fig. 8). The broad outer walls have a fine granulous microstructure. In very deep tangential section the tabulate interspaces replace the wide granulous outer walls.

The mesotheca has numerous median tubuli from which acanthopores develop (Pl. 45, figs. 2,3).

Occurrence.—Stony Mountain formation; Richmond age; GSC 13695, USNM 143047, GSC 6828, a,b.

Age.—Late Ordovician.

Remarks.—*Pachydictya hexagonalis* is similar to *P. robusta* Ulrich in the presence of monticules. Both species have a similar number of acanthopores per zooecium, and a similar number of zooecia per 2 mm., both longitudinally and laterally, and zooecial interspaces of the same width. *P. hexagonalis* has larger zooecia in cross section than *P. robusta*. The depth of colonies of *P. hexagonalis* is smaller than that in *P. robusta*.

No specimens referable to *Pachydictya hexagonalis* have been found in the collec-

TABLE 7—MEASUREMENTS OF *Pachydictya hexagonalis* ULRICH (in millimeters)

Measurements	USNM 143047	GSC 6828b
Zoarial branch depth	1.5–2.0	1.0–1.2
No. of zooecia/2 mm. Longitudinally	4–4.5	not det.
Laterally	6	not det.
Longitudinal interspace	.10–.32	.24–.33
Lateral interspace	.10–.20	.11 approx.
Diameter of zooecia at surface of colony	(.24–.38)×(.20–.24)	(.20–.27)×(.19–.20)
Acanthopores/zooecium	25 minimum	22 minimum
Diameter of acanthopores	.02	.02
Depth of zooecia in mesotheca	.02	not det.

tions examined from Anticosti Island. Thin sections, USNM cat. no. 93582, from an old collection have been referred to *Pachydictya hexagonalis*. These sections show numerous acanthopores in the zooecial walls and median tubuli in the mesotheca. Complete and incomplete curved diaphragms are abundant in the zooecial tubes and first appear in the outer part of the inner zone. These thin sections may be referable to *Peronopora* but at present the taxonomic characteristics of this genus are not known as there is much confusion as to the valid type species of *Peronopora*.

LOCALITIES ON ANTICOSTI ISLAND

English Head formation:

Zone 4. YPM coll. no. 3063/21, Carleton Point, *Stictopora* sp. indet. (YPM cat. no. 21178). USNM cat. no. 93582, Baie Ste. Claire, *Pachydictya* sp. GSC 2256, White Cape, *Pachydictya ambigua*.

Vaureal formation:

Zone 3–4. YPM (Twenhofel 32), second cliff on the west side of Observation Cape, *Stictopora* sp. A (YPM cat. no. 21180).

Zone 4. YPM coll. no. 3063/31, Harvey Point, *Pachydictya ambigua*.

Ellis Bay formation:

Zone 2. YPM coll. no. 3019/57, coral zone, west side of Ellis Bay, *Pachydictya ambigua* (YPM cat. nos. 20810, 20811, 20825, 20824, 21177, 21176, 20816). YPM coll. no. 3063/34, cliff one-half mile east of Junction Cliff, *Stictopora* sp. A (YPM cat. no. 21179), *Ptilodictya ensiformis* (YPM cat. no. 20400).

Zone 6. YPM coll. no. 3063/56, *Hormotoma gigantea* zone, Ellis Bay, *Pachydictya ambigua*.

Zone 7. YPM (Twenhofel 40), unit 9, west side of Ellis Bay, *Pachydictya ambigua*.

Zone 9. USNM cat. no. 69078, west Ellis Bay, *Pachydictya ambigua*.

Zone 10. YPM coll. no. 3063/58, lower zone, Cape Henry, *Ptilodictya ensiformis* (YPM cat. no. 20819), *Pachydictya ambigua* (YPM cat. no. 20813).

Becscie formation:

Zone 1. USNM cat. no. 143034, near Long Point, *Phaenopora superba*. YPM coll. no. 3063/62, west side of Fox Bay, *Pachydictya ambigua* (YPM cat. nos. 20815, 20814), *Ptilodictya sulcata*. YPM coll. no. 3063/63, Reef Point, *Ptilodictya sulcata*, *Phaenopora superba*. GSC 7414, Reef Point, *Phaenopora superba*. USNM cat. no. 55127, Fox Bay *Pachydictya ambigua*.

Zone 2. YPM coll. no. 3063/72, Duck River, *Phaenopora superba*.

Zone 3. YPM coll. no. 3063/68, USNM cat. no. 69036, Little River between Ellis Bay and Becscie River, *Phaenopora superba*. GSC 2352, Wall Cove between Little River and Duck River, *Phaenopora superba*. GSC 7417, GSC 15100, between Little River and Duck River, *Phaenopora superba*. USNM cat. no. 143032, Wreck Beach, *Phaenopora superba*.

Zone 4. YPM coll. no. 3063/101, Whale Cliff, *Phaenopora superba*. GSC 7425, cliffs east of Becscie River, *Phaenopora superba*. GSC 7426, Becscie River, *Phaenopora superba*. YPM coll. no. 3063/66, cliff back from west Becscie River cliff, *Phaenopora superba*, *Ptilodictya* sp. USNM cat. nos. 69035, 143033, west Becscie River cliff, *Phaenopora superba*.

Gun River formation:

Zone 3. YPM coll. no. 3063/104, St. Mary cliff no. 3, *Phaenopora superba*, *Ptilodictya sulcata*.

Zone 4. YPM coll. no. 3019/106, Cape Cloutiers, *Phaenopora superba*.

Jupiter formation:

Zone 4. USNM cat. no. 69103, east Jupiter cliff, *Pachydictya ambigua*. USNM cat. no. 69092, unit 5, East Cliff, *Pachydictya ambigua*.

Zone 9. YPM (Twenhofel 53), mouth of Pavillon River, *Pachydictya ambigua*.

Chicotte formation:

Zone 1. YMP coll. no. 3063/125, The Jumpers 2, *Pachydictya ambigua* (YPM cat. no. 20812), *Ptilodictya sulcata*.

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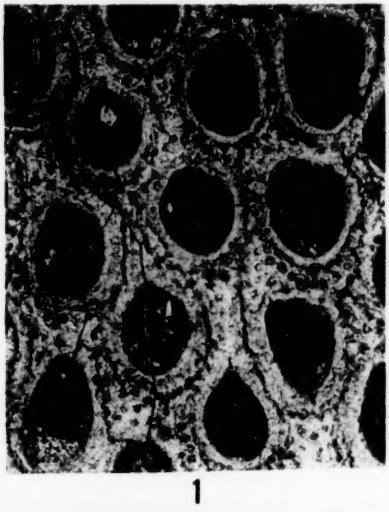
EXPLANATION OF PLATE 45

FIGS. *1–5,7,8*—*Pachydictya hexagonalis* Ulrich, Stony Mountain, Manitoba, Canada; Stony Mountain formation. *1*, Shallow tangential section cut from the holotype showing abundant acanthopores in the wide zooecial walls, USNM 143047. ×50. *2*, Portion of a transverse section showing median tubuli in the mesotheca and narrow tabulate interspaces between zooecia, GSC 6828. ×50. *3*, Portion of a transverse section cut from the holotype showing median tubuli in the mesotheca and tabulate interspaces, USNM 143047. ×50. *4*, External view of part of the holotype, USNM 143047. ×2. *5*, Longitudinal section showing zooecial tubes crossed by diaphragms and narrow tabulate interspaces between zooecia, GSC 6828b. ×50. *7*, Longitudinal section cut from the holotype. Note the short tabulate interspaces at the base of the thickened zooecial walls, USNM 143047. ×50. *8*, Deep tangential section showing interspaces between zooecia, GSC 6828a. ×50.

6,9—*Pachydictya ambigua* Ross, n. sp. *6*, External view of a bifurcate stem. YPM 20812, upper part of the Jumpers, Chicotte formation. ×10. *9*, External view of fragment of a colony showing a lateral margin without zooecia. YPM 20816, West Ellis Bay, Ellis Bay formation. ×10.



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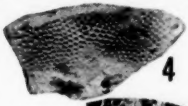

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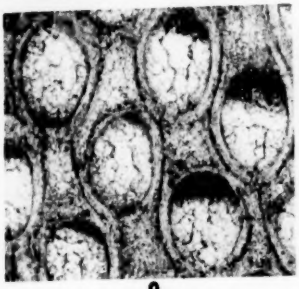

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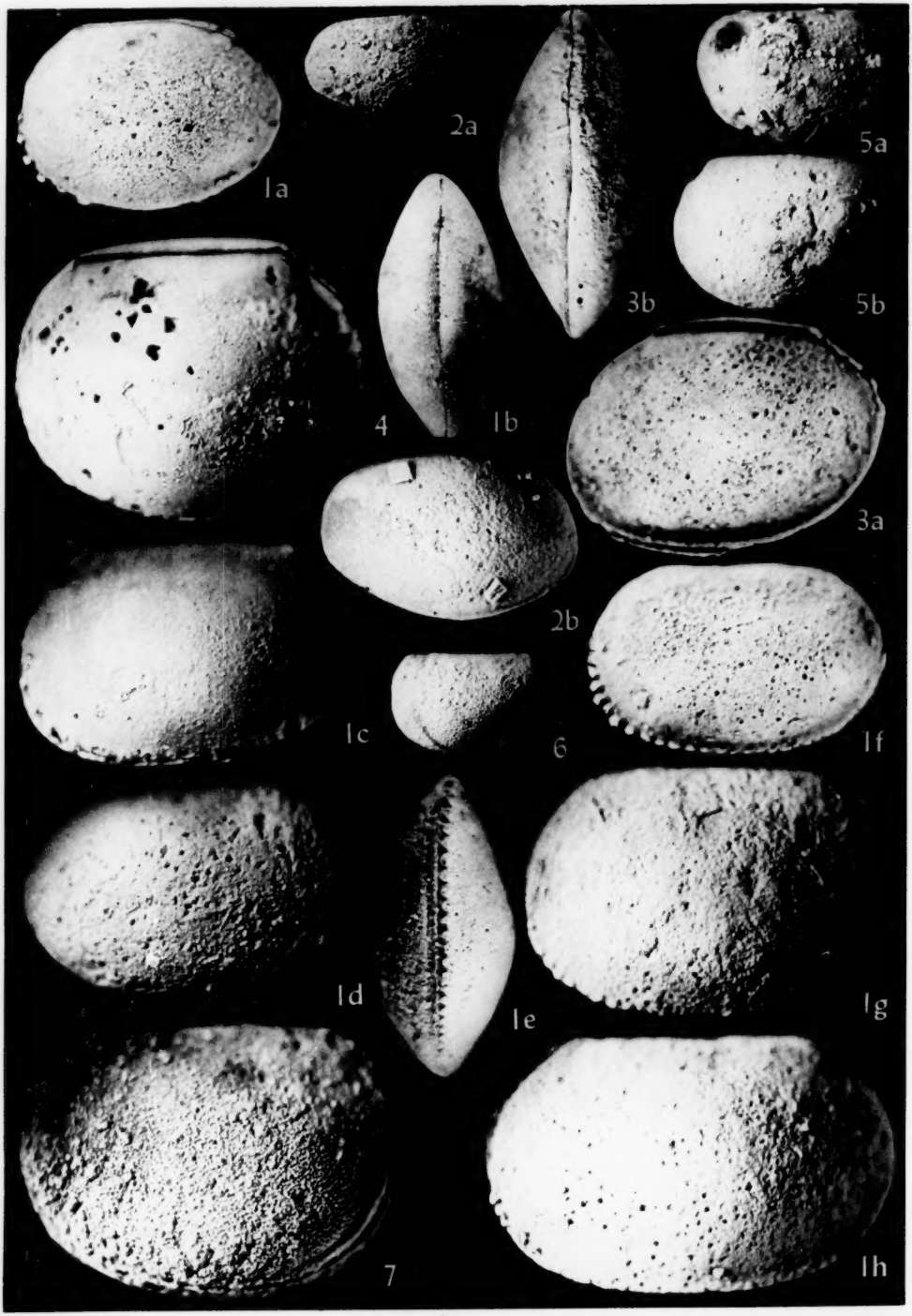
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JOURNAL OF PALEONTOLOGY, V. 35, NO. 2, P. 345–372, PLS. 46–50, 2 TEXT-FIGS., MARCH, 1961

OSTRACODA OF THE FAMILIES APARCHITIDAE, AECHMINIDAE, LEPERDITELLIDAE, DREPANELLIDAE, EURYCHILINIDAE AND PUNCTAPARCHITIDAE FROM THE DECORAH SHALE OF MINNESOTA

FREDERICK M. SWAIN, JAMES R. CORNELL AND DONALD L. HANSEN
University of Minnesota, Minneapolis; Pan American Petroleum Corporation, Farmington, New Mexico; and Sinclair Oil and Gas Company, Tulsa, Oklahoma

ABSTRACT—Ostracoda representing 30 species distributed in 12 genera are described from the Decorah shale of Minnesota. Five of the species, four of the genera and one family are newly described as follows: 1. APARCHITIDAE-*Bullatella granilabiata* (Ulrich) Swain & Cornell, n. gen.; 2. LEPERDITELLIDAE-*Pedomphalella intermedia* Swain & Cornell, n. gen., n. sp., *P. subovata* Swain & Cornell, n. sp., *Byrsolopsina planilateralis* (Kay) Swain & Cornell, n. gen., *Byrsolopsina normella* Swain & Hansen, n. sp.; 3. EURYCHILINIDAE-*Nodambichilina symmetrica* (Ulrich) Swain & Cornell, n. gen., *Tsitrella simplex* Swain & Hansen, n. sp.; 4. PUNCTAPARCHITIDAE Swain, Cornell & Hansen, n. fam. The latter family is believed to be an early representative of the Cytheracea.

Byrsolopsina planilateralis (Kay) and associated species form a zone in the middle Decorah of Minnesota and *Nodambichilina symmetrica* (Ulrich) forms a subzone in the upper part of the *B. planilateralis* zone.

INTRODUCTION

THE classical studies by Ulrich (1894) on the Ordovician ostracodes of Minnesota provided what was at that time a significant advance in knowledge of the earliest Aparchitidae, Leperditellidae, Eurychilinidae, Tetradellidae and other families. His work was in part revised and expanded considerably by Kay (1934, 1940). Few others have studied Ordovician ostracodes from Minnesota, although references to Ulrich's species may be found in many subsequent papers.

The present article is based on studies made by Hansen and Cornell while students at the University of Minnesota, with sub-

EXPLANATION OF PLATE 46

FIG. *1*—*Aparchites fimbriatus* (Ulrich). *1a,b*, Left side and dorsal views of a complete male? shell, ×22, 5.5 feet above base of Decorah, Cannon Falls section, Minnesota. *1c*, Left side of a complete shell, ×30, Trenton limestone, 50 feet above base, just west of Waddle, Centre Co., Pennsylvania. *1d*, Right side of a complete male? shell, ×30, Decorah shale, underpass 2 miles west of Spring Grove, Minnesota. *1e,f*, Ventral and left valve views of a complete female? shell, ×22, 47–49 feet above base of Decorah, Cannon Falls section, Minnesota, *1g*, Left side of a complete male? shell. *1h*, Left side of a complete female? shell, ×30, Decorah shale, 2 miles west of Spring Grove, Minnesota.

2—*Aparchites ellipticus* Ulrich. *2a,b*, Right sides of two immature shells, 79–81 feet and 63–65 feet above base Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. ×30.

3—*Aparchites ellipticus* Ulrich. *3a,b*, Left side and dorsal views of a complete shell, ×30, 7.5–9.5 feet above base of Decorah shale, Cannon Falls section, Minnesota.

4—*Aparchites macrus* (Ulrich). Left side of complete shell, ×30, 49–53 feet above base of Decorah, Cannon Falls section, Minnesota.

5—*Aparchites paratumida* Swain & Cornell, n. sp. *5a*, Right side of paratype, surface of shell imperfect. *5b*, Left side of holotype, a complete shell, having imperfect surface ×30, 59–61 feet above base of Decorah shale, Twin City Brick Plant quarry, St. Paul, Minnesota.

6—*Bullatella granilabata* (Ulrich). Left side of an immature shell, ×30, 23–25 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota.

7—*Bullatella granilabiata* (Ulrich). Left side of a large specimen, ×30, 33–35 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota.

sequent work by Swain. The ostracodes described here represent about a third of the Decorah species, the remainder of which will be described in subsequent papers.

COLLECTING LOCALITIES

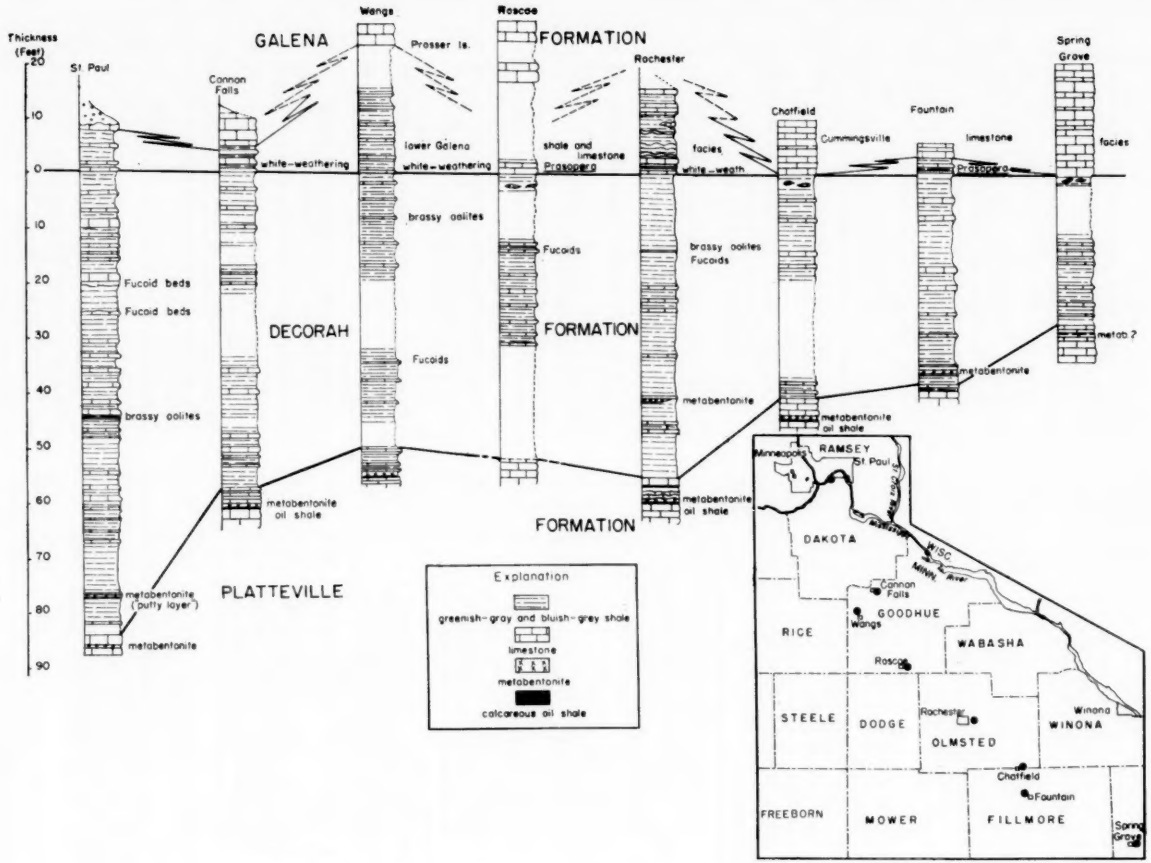
The ostracode specimens described here were obtained by the writers, assisted by John C. Kraft, from four measured sections of the Decorah. These are summarized below and together with additional sections are shown graphically in Text-figure 1.

Fountain Section.—Upper Platteville, Decorah shale and lower Galena limestone from a road cut near Sugar Creek on County Road E, 1.5 miles west of Fountain, Fillmore County, Minnesota.

	Bed (feet)	Total (feet)
GALENA FORMATION		
Gray thin-bedded fossiliferous limestone.	3+	6+
Greenish gray shale and nodular argillaceous fossiliferous limestone; limonitic concentration at base; abundant *Prasopora.*	3.0	3.0
DECORAH FORMATION		
Greenish gray shale, abundant fossils.	4.0	36.9
Thin-bedded gray fossiliferous argillaceous limestone.	1.0	32.9
Greenish gray fissile shale.	2.0	31.9
Gray argillaceous limestone.	1.0	29.9
Greenish gray fissile partly calcareous fossiliferous shale.	8.5	28.9
Gray argillaceous fossiliferous limestone.	1.0	20.4
Greenish gray partly calcareous shale.	2.0	19.4
Gray argillaceous limestone.	1.0	17.4
Greenish gray fissile shale.	4.0	16.4
Gray argillaceous fossiliferous limestone.	0.5	12.4
Greenish gray fissile partly calcareous shale.	3.5	11.9
Gray argillaceous fossiliferous limestone	0.5	8.4
Greenish gray partly calcareous shale.	5.0	7.9
Gray fossiliferous limestone.	0.3	2.9
Greenish gray fissile shale.	0.2	2.6
Fossiliferous argillaceous limestone.	0.1	2.4
Metabentonite (Spechts Ferry bed).	0.2	2.3
Fossiliferous limestone.	0.1	2.1
Greenish gray fissile shale.	2.0	2.0
PLATTEVILLE FORMATION (upper part)		
Gray limestone.	0.3	1.6
Fissile to platy gray shale.	0.3	1.3
Gray medium-bedded limestone.	1.0	1.0

Rochester Section.—Upper Platteville limestone, Decorah shale and lower Galena limestone in quarry 1½ miles east of State Hospital, east of Rochester, Olmstead Co., Minn., 1 mile north of County Road 296.

	Bed (feet)	Total (feet)
GALENA FORMATION		
Concealed to top of hill.		
Gray thin-bedded fossiliferous limestone.	1.0	15.7
Gray shale, poorly exposed.	2.0	14.7
Gray thin-bedded fossiliferous limestone.	2.0	12.7
Gray shale with much nodular light gray and buff limestone.	5.0	10.7
Gray rubbly to medium-bedded fossiliferous argillaceous limestone.	1.7	5.7
Very argillaceous rubbly limestone with gray shale partings.	1.0	4.0
Light gray rubbly fossiliferous limestone.	1.0	3.0
Rubbly argillaceous limestone and greenish gray shale with 3″ of impure limestone at base.	2.0	2.0
DECORAH FORMATION		
Greenish gray fissile shale with abundant brassy oölites at base.	13.6	56.8
Concentration of brassy oölites.	0.3	40.2
Gray argillaceous siltstone with abundant branching fucoids (Fucoid Beds).	1.0	39.9
Greenish gray fissile shale.	5.0	38.9
Greenish gray shale with numerous thin layers of buff fossiliferous limestone.	5.0	33.9
Greenish gray fissile shale.	7.0	28.9
Brown very fossiliferous limestone.	0.3	21.9
Gray and greenish gray shale with limonite concentrate at base.	7.0	21.6
Buff siltstone or silty limestone.	0.2	14.6
Light gray metabentonite ("putty") layer; discontinuous in this quarry.	0.1	14.4
Medium gray fissile shale, platy at top; oxidized limonite zones; few laminae of limestone.	4.3	14.3
Light gray argillaceous limestone.	0.3	10.0
Dark gray platy shale; possible metabentonite layer 4 inches from top.	1.0	9.7
Light gray dense sparsely fossiliferous limestone underlain by dark gray very fossiliferous calcarenite.	0.7	8.7
Gray shale and calcareous platy shale.	8.0	8.0
PLATTEVILLE FORMATION (Carimona Member, upper part)		
Wavy-bedded gray limestone with trilobites and leperditiid ostracodes, shale partings.	1.3	4.1
Shale parting.	0.1	2.8
Gray fossiliferous limestone with wavy copropelic partings.	2.3	2.7
Metabentonite layer ("Carimona" bentonite).	0.2	0.4
Brown platy oil shale.	0.2	0.2



TEXT-FIG. *1*—Stratigraphic sections of the Decorah shale in Minnesota.

Cannon Falls Section.—Upper Platteville limestone, Decorah shale and lower Galena limestone 0.25 miles east of Highway 52 at south edge of Cannon Falls, Goodhue County, Minnesota. Measurements were begun in quarry in Platteville on north side of road and continue east along road for 1 mile to top of Decorah.

	Bed (feet)	Total (feet)
GALENA FORMATION (lower part)		
Thin-bedded white and light gray fossiliferous limestone exposed near top of hill 1 mile east of quarry.	10+	10+
DECORAH SHALE		
Light greenish gray fossiliferous shale, with several 1–2 inch fossiliferous limestone layers, partly concealed.	13.7	38.4
Concealed.	3.4	44.7
Light greenish gray shale and thin fossiliferous limestone.	6.0	41.3
Concealed.	10.5	35.3
Light greenish gray shale, partly concealed and with thin layers of gray coquinoid limestone.	17.0	24.8
Buff argillaceous fossiliferous limestone; upper half has patches in relief on joint surfaces.	1.2	7.8
Greenish gray shale.	0.5	6.6
Buff argillaceous limestone.	0.3	6.1
Light greenish gray fossiliferous shale.	1.5	5.8
Tan and buff argillaceous very fossiliferous limestone.	0.5	4.3
Greenish gray shale containing calcarenite layers of crinoids, brachiopod fragments and ostracodes.	3.8	3.8
PLATTEVILLE LIMESTONE (Carimona Member, upper part)		
Light gray, buff-weathering limestone in a single bed.	0.8	3.2
Light gray and buff calcareous shale.	0.2	2.4
Light gray and buff limestone.	0.8	2.2
Light gray calcareous shale.	0.2	1.4
Light gray and buff limestone.	0.9	1.2
Buff sticky metabentonite underlain by platy dark brown oil shale.	0.3	0.3
Light gray limestone.	—	—

St. Paul Section.—Upper Platteville, Decorah and lower Galena formations in quarry of Twin City Brick and Tile Plant, Cherokee Heights, St. Paul, Minnesota; adapted from Stauffer & Thiel (1941), Hansen (1951) and Cornell (1956).

	Bed (feet)	Total (feet)
GALENA FORMATION		
Bluish gray limestone and interbedded bluish gray shale.	8.3	8.3
DECORAH SHALE		
Bluish gray shale and interbedded bluish gray limestone.	8.3	81.9
Bluish gray limestone.	1.3	73.6
Bluish gray shale with thin layers of argillaceous bluish gray limestone.	5.5	72.3
Bluish gray shale with many thin layers of bluish gray limestone; *Zygospira recurvirostris* very common.	2.8	66.8
Brown iron-stained massive limestone having brown oölitic grains and pebbles at base.	1.8	64.0
Bluish gray shale with fucoidal limestone at top (Fucoid Beds).	5.3	62.2
Bluish gray shale, fucoidal (Fucoid Beds); *Endoceras* and other fossils.	5.0	56.9
Bluish gray shale and lenticular beds of bluish gray limestone (*Chasmatopora* (*Phylloporina*) beds).	8.0	57.9
Bluish gray shale and limestone as above, richly fossiliferous (*Chasmatopora* (*Phylloporina*) beds).	6.0	43.9
Bluish gray shale with brown oölites.	1.0	37.9
Bluish gray ripple marked limestone (*Ctenodonta* beds).	0.2	36.9
Bluish gray shale and interbedded limestone (*Ctenodonta* beds).	3.4	36.7
Bluish gray limestone.	0.3	34.3
Bluish gray shale, soft and fissile.	6.1	34.0
Bluish gray shale and interbedded limestone (*Rhinidictya* beds).	8.2	28.9
Bluish gray limestone (*Rhinidictya* beds).	0.2	20.7
Bluish gray shale and lenticular limestone.	4.0	20.5
Bluish gray soft shale very fossiliferous (*Rhinidictya* beds).	9.1	16.5
Limestone, bluish gray, fossiliferous.	0.3	7.4
Metabentonite, light gray soft (the "putty layer").	0.1	7.1
Bluish gray limestone.	0.3	7.0
Bluish gray shale in part fossiliferous and pyritic.	4.1	6.7
Bluish gray limestone.	0.7	2.6
Bluish gray shale.	1.9	1.9
PLATTEVILLE FORMATION (upper part)		
Bluish gray crystalline limestone.	1.8	3.3
Metabentonite, soft bluish to greenish white, variable ("Carimona" bentonite).	0.3	1.5
Bluish gray to brown pyritiferous limestone.	1.2	1.2

STRATIGRAPHIC DISTRIBUTION OF THE SPECIES

In northern Iowa, it has been possible to recognize three members of the Decorah, in ascending order: Spechts Ferry shale and interbedded limestone, Guttenberg brown, finely crystallized limestone, and Ion calcareous shale and argillaceous limestone (Kay, 1929; Agnew, 1955). In Minnesota these member names are not generally used but Stauffer & Thiel (1941, p. 79) referred to the upper Platteville as the Spechts Ferry member. They also referred to the Ion and Guttenberg in Minnesota (1941, p. 83) as submembers of the Decorah shale member of the Galena formation. They considered the top of the Spechts Ferry member or *Stictoporella* beds of the Platteville to lie at the top of the metabentonite "putty layer" of the Twin City area (Text-fig. 1). The Guttenberg submember they believed was represented by the *Rhinidictya* and *Ctendonta* beds of the middle Decorah and the Ion by the fucoidal and *Chasmatopora* beds of the upper Decorah.

In an unpublished study of the Decorah Ostracoda, Cornell recognized subdivisions based on Ostracoda as follows:

3. *Bollia simplex* zone: upper Decorah.
2. *Byrsolopsina planitaleralis* zone: middle Decorah, including the *Nodambichilina symmetrica* subzone above and the *Eurychilina reticulata* subzone below.
1. *Eurychilina subradiata* zone: lower Decorah.

On the basis of present knowledge, it appears that the *Eurychilina subradiata* zone includes, but is more extensive vertically than, the Spechts Ferry member and its ostracodes are genetically somewhat more closely related to the Platteville than to the overlying main part of the Decorah. The *Byrsolopsina planilateralis* zone is the generalized equivalent of the Guttenberg member and represents the main Decorah fauna. It should be pointed out that the top of the *Byrsolopsina planilateralis* zone is placed at the lowest occurrence of *Bollia simplex*. *B. planilateralis* itself ranges to the top of the Decorah in several of the sections studied. The *Bollia simplex* zone is more or less equivalent to the Ion member, and its ostracode species are generally post-Decorah and are more closely related to the Galena. The summarized distribution of the ostracodes described here is given in Table 1.

DISCUSSION OF THE NEW FAMILY PUNCTAPARCHITIDAE

The genera *Punctaparchites* Kay and *Macrocyproides* Spivey, as treated here, are convex-backed, unequal-ended, faintly sulcate small Ostracoda which exhibit shell characters resembling some primitive Cytheracea as well as Cytherellacea.

There has been considerable uncertainty as to the relationships of *Punctaparchites rugosus*. Having been previously referred to *Cytheropsis* by Jones (1858, p. 249) and to *Cytherella?* by Ulrich (1894, p. 686), it was made the type of *Punctaparchites* by Kay (1934, p. 331). Kay later (1940, p. 245) placed *Punctaparchites* in synonymy with *Macronotella* Ulrich in the belief that the straight margin was dorsal in position. This was accepted by Hessland (1949, p. 189). Henningsmoen, however, treated *Punctaparchites* as a questionably valid genus in the Aparchitidae (1953, p. 268), and Pokorny (1958, p. 149) classified the genus as a valid member of the Aparchitidae.

The present writers believe that the weak internal ridge extending from the curved margin, here taken as the dorsum, inward to midheight, is a reflection of a median sulcus in the animal. This serves to orient the shell with the straighter margin ventral in position and to remove it from the aparchitids. The shape and weak sulcation are reminiscent of several primitive Cytheracea, for example, *Aparchitocythere* Swain & Peterson (1952) from the Upper Jurassic. The circular muscle scar, general shape and particularly the tendency toward ventral truncation of the posterior margin provide a comparison with some species of *Cavellina* Coryell, especially *Cavellina ovatiformis* (Ulrich) from the Upper Mississippian (Cooper, 1941, p. 37). The writers are inclined to favor arrangement with the Cytheracea rather than the Cytherellacea on the basis of the median sulcus.

Two genera, *Punctaparchites* and *Macrocyproides*, are included in the new family, which is apparently confined to the Ordovician.

TABLE 1—STRATIGRAPHIC DISTRIBUTION IN MINNESOTA OF SOME DECORAH OSTRACODA

Species	Lower Decorah	Middle Decorah	Upper Decorah	Lower Galena
APARCHITIDAE				
Aparchites fimbriatus (Ulrich)	rrrrrrrrrrrr	rrrrrrrrrrrr	rrrrrrrrrrrr	
Aparchites ellipticus Ulrich	rrrrrrrrrrrr	rrrrrrrrrrrr?		
Aparchites macrus (Ulrich)	rrrrrrrrrrrr	rrrrrrrrrrrr	rrrrrrrrrrrr	
Aparchites paratumida Swain & Cornell, n. sp.	rrrrrrrrrrrr	rrrrrrrrrrrr	rrrrrrrrrrrr	
Bullatella granilabiata (Ulrich)	rrrrrrrrrrrr	rrrrrrrrrrrr	rrrrrrrrrrrr	
Macronotella scofieldi Ulrich			rrrrrrrrrrrr	rrrrrrrrrrr
Sacceltia arrecta (Ulrich)	aaaaaaaaaa	aaaaaaaaaa	aaaaaaaaaa	
Sacceltia angularis (Ulrich)		rrrrrrrrrrrr		
Saccelatia arcuamuralis Kay	rrrrrrrrrrrr	rrrrrrrrrrrr	rrrrrrrrrrrr	
Saccelatia bullata Kay	rrrrrrrrrrrr	rrrrrrrrrrrr		
Saccelatia cletifera Kay		rrrccccrrrr	rrrrrrrrrrrr	
Aechmina ionensis Kay		rrrrrrrrrrrr	rrrrrrrrrrrr	
LEPERDITELLIDAE				
Schmidtella umbonata Ulrich	vvvvvvvvv	vvvvvvvaa	aaaaaaaaaa	
Schmidtella affinis Ulrich	aaaaaaaaaa	aaaaaaaaaa	aaaaaaaaaa	
Schmidtella brevis Ulrich		rrrrrrrrrrrr		
Schmidtella incompta Ulrich	aaaaaaaaaa	rrrrrrrrrrrr	aaaaaaaaaa	aaaaaaaaa
Pedomphalella intermedia Swain & Cornell, n. sp.		rrrrrrrrrrrr		
Pedomphalella subovata Swain & Cornell, n. sp.	rrraaaaaaaa	accccccccca	aaaaaarrr	rrrrrrrr?
Cryptophyllus oboloides (Ulrich & Bassler)	rrr	aaaaaaaaaa	aaaaaaaaa	aaaa?
Byrsolopsina planilateralis (Kay)	a	aaaaaaaaaa	aaaaaa	
Byrsolopsina centipunctata (Kay)	rrrr	rrrrrrrrrrr	rrrrrrrrrrr	
Byrsolopsina ovata (Kay)	rrrrrrrrrrrr	rrrrrrrrrrrr	rccccccccc	cccc
LEPERDITELLIDAE				
Byrsolopsina normella Swain & Hansen, n. sp.		ccccccccccc		
Parenthatia punctata (Ulrich)		vvvvvvvvv	vvvvvvvvv	
Parenthatia camerata Kay			vvvvvvvvv	
EURYCHILINIDAE				
Nodambichilina symmetrica (Ulrich)		rrrrraaaaaa	aaaaaaaaaa	rrr
Tsitrella simplex Swain & Hansen, n. sp.		aaaaaa	rrrrrrrrrrrr	
PUNCTAPARCHITIDAE				
Punctaparchites rugosus (Jones)	aaaaaaaaaa	aaaaaaaaaa	aaaaaaaaaa	
Punctaparchites multipunctata (Kay)				
Macrocyproides trentonensis (Ulrich)	aaaaaaaaaa	aaaaaaaaaa	aaaaaaaaaa	aaaaaaaaa

Abundance of species, based on a slide of approximately 100 specimens: r, rare (1–5); c, common (6–10); a, abundant (11–25); v, very abundant (26+).

ACKNOWLEDGEMENTS

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SYSTEMATIC DESCRIPTIONS

Superfamily APARCHITACEA Jones, 1901
Family APARCHITIDAE Jones, 1901

Straight hinged, nonsulcate small to medium-sized, subelliptical to subquadrate ostracodes; valves equal to slightly unequal in size, overlapping along entire free margin

or only along venter; edge of smaller valve typically fitting into a groove in larger valve; greatest convexity submedian; dorsal surface may protrude beyond hinge line; surface smooth, striate or punctate, the latter may have inner expanded portions and presumably contained sensory bristles; shell wall may consist of an inner structureless layer and an outer prismatic layer (Schmidt, 1941; Hessland, 1949; Kraft, 1955).

The Decorah shale contains three previously described genera and one new genus belonging to this family: *Aparchites* Jones, *Bullatella*, Swain & Cornell, n. gen., *Macronotella* Ulrich and *Saccelatia* Kay. *Ceratocypris* Poulsen (1934) and *Pinnatulites* Hessland (1949), although included in Leperditellidae in recent years, were considered to be *Aparchites* by Hessland (1949).

Genus APARCHITES Jones, 1889

Shell subelliptical, straight-hinged, medium-sized, smooth or pitted, moderately convex with greatest convexity median to ventromedian; right valve larger than left, but left may over-reach right ventrally; free inner marginal surface of right valves typically rabbeted for reception of edge of left; a narrow marginal ridge borders free margins of each valve; free margin of left valve spinose.

Type species.—*Aparchites whiteavesi* Jones.

Geologic Range.—Ordovician to Devonian.

APARCHITES FIMBRIATUS (Ulrich)

Pl. 46, figs. 1a–h; text-fig. 2a

Leperditia fimbriata ULRICH, 1892, Am. Geol., v 10, p. 268, pl. 9, figs. 34–36.

Aparchites fimbriatus (Ulrich) ULRICH, 1894, Final Rept., Geol. and Nat. Hist. Surv. Minn., v. 3, p. 645, pl. 45, figs. 10–12; GRABAU & SHIMER, 1910, N. Am. Index Fossils, p. 343, text-fig. 1657b; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 53; LADD, 1928–30, Iowa Geol. Surv., v. 34, p. 39; SWAIN, 1957, Jour. Paleontology, v. 31, p. 561, pl. 61, figs. 13a–e; HARRIS, 1957, Okla. Geol. Survey, Bull. 75, p. 144.

Aparchites carinatus KAY, 1940, Jour. Paleontology, v. 14, p. 244, pl. 29, figs. 29–32.

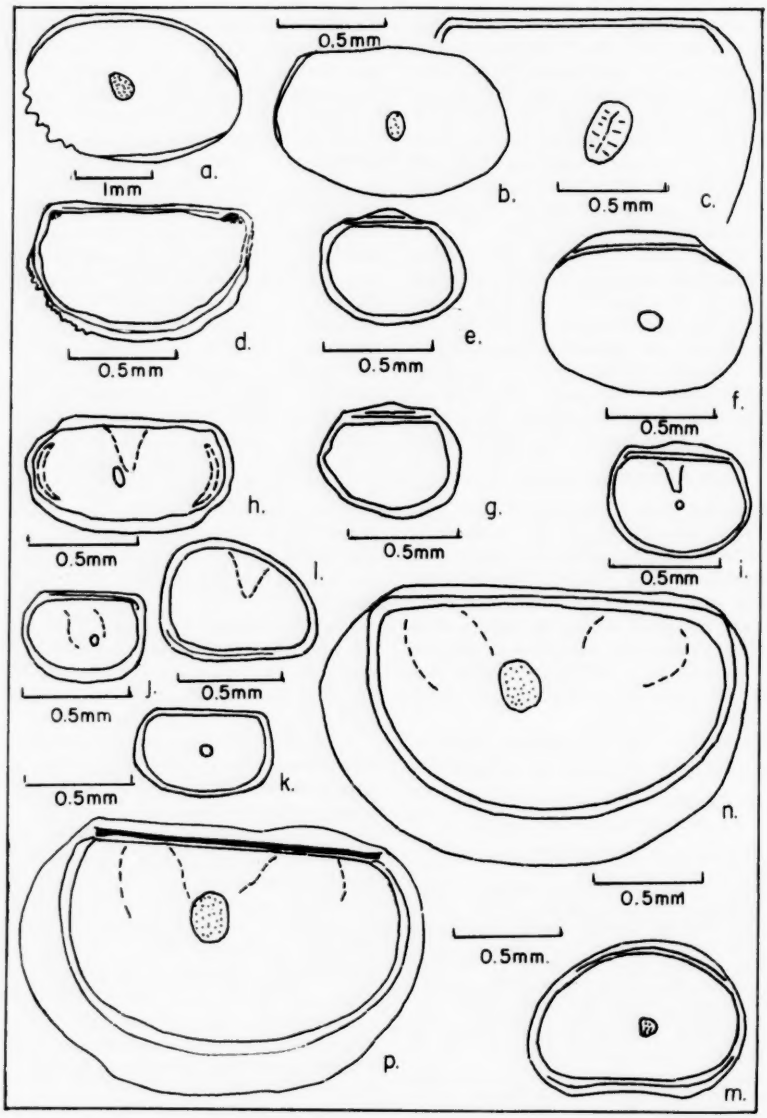
Leperditella canalis ULRICH, 1894, Final Rept., Geol. and Nat. Hist. Survey Minn., v. 3, p. 637, pl. 43, figs. 1–3.

Adult shell 2 mm. or more in length. Lateral outline of valves subovate to subelliptical, highest medially to anteromedially; dimorphism present, presumed females more elongate and elliptical than supposed males; anterior margin more broadly rounded than posterior in males, nearly equally rounded in females, but posterior margin slightly extended above in both dimorphs; right valve over-reaches left along dorsum and dorsal part of ends; a nodose or spinose flange occurs along venter and ventral part of ends; in immature molt valves flange may be formed into a frill consisting of closely spaced spines; in mature forms this may be reduced to a slightly spinose low ridge; corresponding features not present in right valve, the ventral edge of which is over-reached by edge of left valve. Hinge margin varies from half of shell length in male dimorphs to about two-thirds of shell length in females. As described by Kraft (1955) hinge of left valve consists of a narrow bar with socket depressions at each end, and in right valve a grooved interterminal surface and small knoblike teeth terminally. Free marginal areas with a narrow duplicature. Free margins of left valve finely denticulate. Muscle scar a large smooth area slightly anterior to middle.

Length of a male specimen (Pl. 46, fig. 1g) 2.0 mm., height 1.43 mm., convexity 1.01 mm.; length of a female specimen (Pl. 46, fig. 1h) 2.23 mm., height 1.50 mm., convexity 1.13 mm.

Remarks.—This species is noteworthy for the variation in the marginal velate structure of the left valve which varies from a few widely spaced spines to a broad frill composed of numerous coalescing spines. *Hyperchilarina nodosimarginata* (Harris) and related species from the Simpson group of Oklahoma generally fall within the limits of variability in *A. fimbriatus*, although as oriented by Harris (1957, p. 143) Oklahoma species have the left valve larger than the right, not the reverse as in *A. fimbriatus*.

Occurrence.—The species occurs rarely in the Decorah shale at St. Paul from 3 feet to 63 feet above the base of the formation; at Cannon Falls it is rare 7.5 to 9.5 and 53 to 55 feet above the base; at Rochester it occurs rarely 32 to 36 feet above the base; it was not found in the Decorah at the Sugar Creek locality, Minnesota. Elsewhere the species occurs in the Chazyan Day Point formation on Valcour Island, Lake Champlain, New York; in the Lincolnshire and lower Edin-



TEXT-FIG. 2—Details of ostracode morphology.

a. *Aparchites fimbriatus* (Ulrich). Left side, showing muscle scar; 5.5 feet above base of Decorah, Cannon Falls section.

b. *Aparchites ellipticus* Ulrich. Right side, showing muscle scar; 63–65 feet above base of Decorah, St. Paul brick plant section.

c. *Bullatella granulabiata* (Ulrich). Part of left valve interior, showing muscle scar; 45–47 feet above base of Decorah, St. Paul brick plant section.

burg formations, Chazyan and Black River and of the Shenandoah Valley, Virginia; it was originally described by Ulrich from the Maquoketa formation near Spring Valley, Minnesota, but the writers have not seen specimens from the Maquoketa. A sample 50 feet above the base of Trenton limestone, from Waddle, Centre County, Pennsylvania, yielded *A. fimbriatus*.

APARCHITES ELLIPTICUS Ulrich
Pl. 46, figs. 2a,b, 3a,b; text-fig. 2b

Aparchites ellipticus ULRICH, 1894, Final Report, Geol. and Nat. Hist. Survey of Minn., v. 3, pt. 2, p. 644, pl. 43, figs. 15–17; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 53.
?*Aparchites maccoyii* (Salter) HARRIS, 1957 (part), Okla. Geol. Survey Bull. 75, p. 139.

Shell ovate-elliptical in side view; highest medially; dorsal margin gently convex with broadly obtuse, not sharply defined, cardinal angles at end of short hinge line; ventral margin more gently convex than dorsal; anterior margin broadly rounded, extended below, posterior margin more narrowly rounded extended medially. Right valve larger than left extending beyond the other middorsally, less strongly ventrally. Valves moderately convex, greatest convexity median.

Left valve with a narrow elevated rim bordering free margin; ventrally rim is strongly elevated and produces a deep submarginal groove on its inner flank; posterior and anteroventral portions of rim bear short spines. General surface bears scattered pits of moderate size, except medially in area of adductor muscle scar where surface is smooth.

Length of a figured specimen (Pl. 46, fig. 3) 1.83 mm., height 1.33 mm., convexity 0.98 mm.

Remarks.—The elliptical outline and short hinge, together with ventral marginal rim and subjacent groove on left valve are distinguishing characteristics of the species. The nonvelate forms of *A. maccoyii* (Salter) described by Harris (1957) from the Simpson group of Oklahoma may represent this species. No frilled or velate forms like those in the Simpson or in the Chambersburg limestone of Virginia (Kraft, 1955) were found in the Decorah.

Occurrence.—The species is rare in the Decorah 7.5–9.5 feet above the base, Cannon Falls, Minnesota. Ulrich originally recorded it from the middle Decorah at Minneapolis and questionably from the Decorah at Cannon Falls, Minnesota.

APARCHITES MACRUS (Ulrich)
Pl. 46, fig. 4

Leperditella macra ULRICH, 1894, Final Rept. Geol. and Nat. Hist. Survey, v. 3, pt. 2, p. 638, pl. 43, figs. 7–9; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 696; BASSLER & KELLETT, 1934, Geol. Soc. Am. Special Paper 1, p. 374.
Leperditia macra (Ulrich), MILLER, 1897, N. Am. Geol. Paleont., 2nd App., p. 788.

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d. *Saccelatia arrecta* (Ulrich). Left valve interior; 7.5–9.5 feet above base of Decorah, Cannon Falls section.
e. *Schmidtella umbonata* Ulrich. Left valve interior; 3.5–5.5 feet above base of Decorah, Cannon Falls section.
f. *Schmidtella affinis* Ulrich. Right valve interior showing muscle scar; 7.5–9.5 feet above base of Decorah, Cannon Falls section.
g. *Schmidtella umbonata* Ulrich. Right valve interior; 3.5–5.5 feet above base of Decorah, Cannon Falls section.
h. *Parenthatia camerata* Kay. Right valve interior, 32–36 feet above base of Decorah, Sugar Creek section near Fountain, Minnesota.
i. *Pedomphalella subovata* Swain & Cornell, n. sp. Right valve interior; 17.5–20.5 feet above base of Decorah, Cannon Falls section.
j. *Byrsolopsina planilateralis* (Kay). Interior of relatively short left valve; 36–40 feet above base of Decorah, Cannon Falls section.
k. *Byrsolopsina planilateralis* (Kay). Interior of elongate left valve; 37–39 feet above base of Decorah, St. Paul brick plant section.
l. *Macrocyproides trentonensis* (Ulrich). Interior of left valve, 5.5–7.5 feet above base of Decorah, Cannon Falls section.
m. *Punctaparchites rugosus* (Jones). Right valve interior; 40–44 feet above base of Decorah, Sugar Creek section.
n, p. *Nodambichilina symmetrica* (Ulrich). 14, Left valve interior, 23–27 feet above base of Decorah, and 15, right valve interior 36–40 feet above base of Decorah, Cannon Falls section.

Shell short and high, subelliptical-subquadrate in side view; highest medially; dorsal margin nearly straight, slightly more than half of the shell length, with anterior cardinal angle less obtuse than posterior; ventral margin moderately convex; terminal margins broadly rounded, the anterior extended medially, the posterior slightly extended below, subtruncate above. Right valve the larger, extending strongly beyond left along hinge margin, less strongly ventrally and posteriorly, and not at all anteriorly. Valves somewhat compressed, greatest convexity ventromedian.

Posteromedian to posterodorsal part of shell compressed below general surface; anterior margins bear a few weak spines or pustules; surface otherwise smooth. Internal features not seen.

Length of figured specimen 2.03 mm., height 1.43 mm., convexity 1.03 mm.

Remarks.—The lack of a median sulcus separates this species from *Leperditella*, and small size, lack of eye tubercles, and presence of strong dorsal overlap separate it from the Leperditiidae. The posterior compression of the valves, together with the short high outline, was cited by Ulrich as diagnostic, but his orientation of the species is here reversed.

Occurrence.—The species is rare to frequent from the base to 41 feet above the base of the Decorah at St. Paul; frequent at 7.5–9.5 and rare at 49–53 feet above the base of the Decorah at Cannon Falls, Minnesota. Ulrich recorded it from the middle third of the Decorah at Minneapolis.

APARCHITES PARATUMIDA Swain & Cornell, n. sp.
Pl. 46, fig. 5a,b

Shell subovate in lateral view, highest medially; dorsal margin straight about five-eighths of shell length, with distinct, broadly obtuse cardinal angles; ventral margin strongly convex; anterior margin broadly rounded, extended medially; posterior margin more narrowly rounded, extended above. Right valve a little larger and extending beyond the left along anterior and ventral margins. Valves strongly convex with greatest convexity posteroventral in position. Surface mostly smooth, but possibly with scattered pits. Internal features not seen.

Length of holotype (Pl. 46, fig. 5b) 1.21 mm., height 0.88 mm., convexity 0.70 mm.

Relationships.—The outline, size, nature of overlap and particularly the strong convexity of the valves are features relating the present specimens to those described as *Isochilina labellosa* Jones (1891, p. 69). The small size and lack of marginal flattened areas prevent arrangement with *Isochilina;* furthermore Swain (1957, p. 546) considered *I. labellosa* to belong with *Eoleperditia*. The size, shape and similarity of valve size are evidence for placing the present species in *Aparchites*. Ulrich's species *Leperditia tumida* (1892, p. 264) from the "Birdseye" limestone at High Bridge, Kentucky, is very close to the present species, but as described, may be larger and less convex. Several species from the Simpson of Oklahoma assigned to *Leperditella* (Harris, 1957) are close to the present form in shape overlap and convexity, *i.e.*, *L. brookingi* Harris, *L. obesa* Harris, and *L. tumida* (Ulrich). The lack of a median sulcate depression in our Decorah specimens prevents placing them in *Leperditella*, and judging from Harris' descriptions and illustrations, his species also may lack sulci.

Occurrence.—This species is rare in the upper Decorah 59–61 feet above the base at St. Paul; rare in the lower and upper Decorah 7.5–9.5 and 45–47 feet above the base at Cannon Falls; rare in the upper Decorah 24–28 feet above the base at Rochester; and rare in the upper Decorah 36–40 feet above the base at Sugar Creek, Minnesota.

Genus BULLATELLA Swain & Cornell, n. gen.

Subelliptical-subquadrate, medium-sized aparchitids with pronounced midventral swelling and a low narrow ridge or row of spines adjacent to free margin of each valve. Surface punctate; adductor muscle area submedially located and consists of a circular to oval spot. Ordovician.

The genus is closely similar to *Pinnatulites* Hessland (1949) from the Ordovician of Sweden but submarginal ridges or spines are not present in that genus. *Bullatella* is distinguished from *Aparchites* by the midventral swelling.

Type species.—*Leperditia granilabiata* Ulrich 1892.

Geologic Range.—Ordovician.

BULLATELLA GRANILABIATA (Ulrich)
Pl. 46, figs. 6,7; Pl. 47, figs. 1a–c,2; text-fig. 2c

Leperditia granilabiata ULRICH, 1892, Am. Geol. v. 10, p. 267, pl. 9, figs. 31–33.
Aparchites granilabiatus (Ulrich), ULRICH, 1894, Geol. and Nat. Hist. Surv. of Minn., Final Rept., v. 3, p. 644, pl. 45, figs. 21–23; BASSLER & KELLETT, 1934, Geol. Soc. Am., Special Paper 1, p. 154; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 53.

Shell subelliptical-subquadrate in lateral view, hinge margin straight, about two thirds of shell length, ventral margin moderately convex; anterior margin broadly rounded, slightly extended above; posterior margin a little less broadly rounded, extended medially, and forming a more obtuse cardinal angle with dorsum than anterior margin; valves subequal but left is slightly larger; valves strongly convex, greatest convexity ventro-median, where surface is moderately to strongly expanded and may overhang ventral margin. Surface finely and closely punctate.

Length of a large figured specimen (Pl. 46, fig. 7) 1.96 mm., height 1.26 mm., convexity 1.13 mm. Dimensions of a smaller and relatively higher shell (Pl. 2, fig. 1b), probably an immature specimen, length 1.53 mm., height 1.11 mm., convexity 0.86 mm.

Remarks.—This species is very close to *Bullatella kauffmanensis* (Swain) from the lower Middle Ordovician of the eastern United States, but that species is more equal-ended and has the area of the adductor muscle scar slightly raised above the general surface. Ulrich's interpretation of the surface ornamentation as finely pustulose rather than punctate apparently was based on weathered specimens in which the interstices between the pits were worn down, leaving the matrix-filled pits standing in relief.

Occurrence.—The species occurs rarely to frequently in the Decorah shale at St. Paul from 3 to 63 feet above the base; at Cannon Falls it is rare in the lower Decorah from 5.5 to 7.5 feet above the base; at Rochester it is rare in the lower 8 feet of the Decorah; and in the Sugar Creek section near Fountain, Minnesota, it is rare from 8 to 28 feet above the base of the Decorah. Ulrich described the species from the upper third of the "Trenton" shales at St. Paul, Minnesota. He also recorded from the lower Trenton shales a variety that is more elongate, has less convex venter and lacks surface ornamentation. The identity of this variety is obscure.

Genus MACRONTELLA Ulrich, 1894

Carapace small to medium sized, subsemicircular in lateral view; hinge very long, but with slightly obtuse cardinal angles; surface without ridges or sulci, but with coarse punctations and smooth median area overlying muscle scar, valves moderately convex.

Type species.—*Macronotella scofieldi* Ulrich, 1894.

Geologic Range.—Ordovician-Devonian?

MACRONOTELLA SCOFIELDI Ulrich
Pl. 47, figs. 3a,b

Macronotella scofieldi ULRICH, 1894, Final Rept., Geol. and Nat. Hist. Survey, Minn., v. 3, pt. 2, p. 684, pl. 43, figs. 30–34; GRABAU & SHIMER 1910, N. Am. Index Foss., p. 348, text-fig. 1657 u,v; Bassler, 1915, U. S. Natl. Mus. Bull. 92, p. 781; ULRICH & BASSLER, 1923, Md. Geol. Surv., Silurian vol., p. 315, 316, t. fig. 22–27.
Isochilina scofieldi (Ulrich), MILLER, 1897, N. Am. Geol. Paleont., 2nd App., p. 788.

Shell subhemispherical in side view, hinge margin straight and relatively long, about five-sixths of shell length; cardinal angles well defined not greatly obtuse; ventral margin strongly convex, coming to a rounded apex slightly behind middle; anterior margin somewhat less broadly rounded and more extended above than is posterior margin. Right valve slightly larger than left, overreaching it along free margins, but along hinge, left valve extends beyond right. Valves moderately convex with greatest convexity in an anteroventral position. Dorsal slopes somewhat compressed, but not visibly sulcate on exterior of valves. General valve surface set with widely spaced rather large punctae; marginal areas and small median muscle scar area smooth. Interior of valves not seen.

Length of figured specimen 1.18 mm., height 0.81 mm., convexity 0.53 mm.

Remarks.—The comparatively long hinge and coarsely punctate surface distinguish this species from other *Macronotella*.

Occurrence.—The species is rare in the upper Decorah, 55–58 feet above the base,

at Cannon Falls, Minnesota. Ulrich recorded it originally from the lower Galena at Cannon Falls, and also from the Lowville limestone at High Bridge, Kentucky.

Genus SACCELATIA Kay, 1940

Carapace small to medium sized; subelliptical to subsemicircular, valves subequal; hinge straight and nearly equal to shell length; free margins adjoined by a fringe of spines or spinose ridges; ventral and terminal portions of valves may have strongly elevated large nodes or wide ridges; general surface typically punctate; hingement formed by simple valve contact.

Type species.—*Aparchites arrectus* Ulrich, 1894.

Geologic Range.—Ordovician.

SACCELATIA ARRECTA (Ulrich)
Pl. 47, figs. 4a–e; text-fig. 2d

Aparchites arrectus ULRICH, 1894, Final Rept. Geol. and Nat. Hist. Survey of Minn., v. 3, pt. 2, p. 646, pl. 43, figs. 35,36; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 53.

Saccelatia arrecta (Ulrich) KAY, 1940, Jour. Paleontology, v. 14, p. 243, pl. 29, figs. 12–16; SHIMER & SHROCK, Index Fossils of N. Am., p. 665, pl. 280, figs. 38–40; Swain, 1957, Jour. Paleontology, v. 31, p. 561, pl. 62, fig. 6.

Shell subquatrate-subelliptical in side view; dorsal margin straight and nearly equal to shell length, highest slightly posterior to middle; ventral margin strongly convex; ends rounded, the anterior a little narrower than posterior, meeting dorsal margin with nearly equal, distinct, and only slightly obtuse, cardinal angles. Valves equal in size, moderately convex, with greatest convexity ventro-median; valve surface slopes steeply to margin in ventral half, but very gradually to dorsal margin. Free margins bordered by about 50 blunt spines or pustules set a short distance from contact of valves. Valve surfaces densely set with small punctae.

Hingement formed by simple contact of straight dorsal edges of valves. Free margin of left valve with a narrow inner shelf, but there is no evidence that this acts as a selvage surface. Muscle scar not seen.

Length of a figured complete specimen (Pl. 47, fig. 4a) 0.75 mm., height 0.47 mm., convexity 0.30 mm.

Remarks.—*Saccelatia arrecta* is distinguished from other members of the genus by its lack of ridges or nodes on the ventral surface.

Occurrence.—The species varies from rare to very abundant in the Decorah shale, from 3–63 feet above the base at St. Paul; rare to abundant throughout the Decorah at Rochester; rare to very abundant from the base to 36 feet above the base at Sugar Creek, near Fountain, Minnesota. Kay (1940, p. 243) found it frequently in the Ion member of the Decorah near Cannon Falls, Minnesota, and rare in the Ion member in Glenwood Township, Winneshiek County, Iowa.

SACCELATIA ANGULARIS (Ulrich)
Pl. 47, figs. 5a,b

Moorea angularis ULRICH, 1894, Final Rept. Geol. and Nat. Hist. Survey of Minn., v. 3 pt. 2, p. 682, pl. 43, fig. 89, pl. 46, figs. 15,16.

Saccelatia angularis (Ulrich), KAY, 1940, Jour. Paleontology, v. 14, p. 243, pl. 29, figs. 17–20.

Shell subquadrate-subelliptical in side view; hinge margin straight, only slightly less than shell length and with well defined cardinal angles, the anterior of which is a little less obtuse than the posterior; ventral margin moderately convex; terminal margins broadly rounded, the anterior somewhat narrower than posterior; valves nearly equal in size, the left extending slightly beyond right along hinge margin, but ventrally right overlaps and slightly overreaches left. Convexity of valves rather low, most convex midventrally.

A narrow distinct but low ridge situated within margin about one-sixth (on right valve) to one-eighth (on left valve), of length of shell, parallels free margins of each valve in ventral two-thirds; ends of ridge merge gradually with valve surface below cardinal angles. Free margin of each valve flattened, liplike and bearing a row of short spines. General surface of valves delicately reticulate, with a tendency for alignment of the reticules parallel to margins occurring on ventral ridge. Internal structures not seen.

Length of figured specimen (Pl. 47, fig. 5a) 0.76 mm., height 0.46 mm., convexity 0.30 mm.

Remarks.—As compared to *S. arcuamuralis* Kay the ventral marginal ridges of this species are less strongly elevated, extend farther toward dorsum, and their terminations merge gradually with shell sur-

face rather than ending in bulbous expansions. The possibility exists that *S. angularis* represents the immature stages of *S. arcuamuralis*, but too few specimens are available to verify this possibility.

Occurrence.—The species is rare in the middle Decorah 47–49 feet above the base at St. Paul. Kay (1940, p. 243) recorded it from the Guttenberg member of the Decorah of northeastern Iowa and Minnesota and from the Ion member in Iowa. Ulrich described it from the *Rhinidictya* beds, Decorah, at Minneapolis.

SACCELATIA ARCUAMURALIS Kay
Pl. 47, figs. 6a–d

Saccelatia arcuamuralis KAY, 1940, Jour. Paleontology, v. 14, p. 243, pl. 29, figs. 25–28.

Shell subquadrate in side view, highest medially, dorsal margin straight, six-sevenths of shell length and with well defined cardinal angles, of which the anterior is slightly obtuse and the posterior nearly normal; ventral margin moderately convex; terminal margins broadly rounded, the anterior a little the narrower. Valves nearly equal, the right slightly larger than left; convexity of valves, other than in ventral ridge, low.

A prominent, strongly elevated carina or submarginal ridge occupies ventral half of each valve parallel to margin and overhanging general valve surface as seen from the side; ridges on both valves occur farther up anterior than up posterior end. One or both ends of ridge bulbously enlarged, that at posterior end of ridge generally larger than at anterior end. Free margin of right valve bears numerous closely spaced short spines or pustules. General surface of well preserved specimens ornamented by a faint reticulate or pitted pattern, with a lineation of reticules more or less parallel to valve margin.

Length of figured specimen (Pl. 47, fig. 6a) 0.98 mm., height 0.62 mm., convexity 0.40 mm.

Remarks.—Even in the few specimens at hand there is considerable variation in the width of the ventral ridge, and in development of bulbous expansions at its ends. Not enough comparative material is at present available to determine possible taxonomic significance of these variations.

As compared to *S. angularis* (Ulrich) the ventral ridge of *S. arcuamuralis* is more sharply defined, higher, and does not extend as far toward dorsum as does the ridge in *arcuamuralis*.

Occurrence.—This species is rare in the middle Decorah at St. Paul; rare in the lower and upper Decorah at Cannon Falls; and was not found at Rochester or at Sugar Creek, near Fountain, Minnesota. According to Kay (1940, p. 243) the species is rare in the Ion member of the Decorah at Ellsworth, Wisconsin and in northeastern Iowa.

SACCELATIA BULLATA Kay
Pl. 47, figs. 7 a–e

Saccelatia bullata Kay, 1940, Jour. Paleontology, v. 14, p. 243, pl. 29, figs. 21,22.

Shell subquadrate in lateral view, highest medially to anteromedially; dorsal margin straight about seven-eighths of shell length; cardinal angles distinct, and slightly obtuse and one or both may have small compressed "ear"-like extensions; ventral margin moderately convex; posterior margin gently and broadly rounded, subtruncate below, slightly extended above; anterior margin more broadly rounded, extended medially. Valves nearly equal in size, the right slightly larger and overlapping left along free margins; dorsally left valve extends a small distance beyond right.

Most prominent feature of surface ornamentation is the occurrence midventrally, on each valve, of two thick, blunt nodes, each lying about one-third distance from nearest terminal margin, the posterior node axis more inclined than the anterior. General valve surface, except smooth marginal zone and rounded anteromedian muscle scar area, finely and densely pitted; surfaces of nodes also pitted; free margin of each valve bears a low submarginal narrow ridge on which occur small spinose projections. Middorsal portion of each valve in some specimens has a broad, very shallow depression, possibly representing a median sulcus. Internal structures not seen.

Length of a figured specimen (Pl. 47, fig. 7e) 0.80 mm., height 0.50 mm., convexity exclusive of ventral nodes 0.36 mm.

Remarks.—The orientation of this species was determined by the relative proximity of the muscle scar spot to the more broadly

rounded end, and by the relative size and overlap of the valves. This orientation results in the more broadly rounded terminal margin being placed anteriorly, whereas in the other species of *Saccelatia* described here, the posterior margin is a little the broader. The anterodorsal depression of the valve surfaces in some of the specimens is reminiscent of that found in *Leperditella millepunctata* (Ulrich). Whether or not this feature is sufficient to ally *Saccelatia* with the *Leperditellidae* rather than the *Aparchitidae* is uncertain, but for the present it will be left in the latter family.

Occurrence.—The species is rare in the lower and upper Decorah 17.5 to 20.5 feet, 46.8 to 49.1 feet and 50 to 52.6 feet above the base at Cannon Falls; and is rare in the middle Decorah 43 to 53 feet above the base at St. Paul. Kay originally described a single specimen from the Ion member of the Decorah, Glenwood Township, Winnishiek County, Iowa.

Saccelatia cletifera Kay
Pl. 47, figs. 8a,b; Pl. 48, figs. 1a–d

Saccalatia cletifera Kay, 1940, Jour. Paleontology, v. 14, p. 243, pl. 29, figs. 23,24.

Shell subquadrate in lateral view, highest anteromedially; hinge margin straight, slightly less than shell length, with well marked cardinal angles, the anterior nearly a right angle, the posterior slightly obtuse; ventral margin strongly convex in shorter dimorphs, only moderately convex in elongate dimorphs; terminal margins broadly rounded, posteriorly subtruncate below, extended above. General surface of valves moderately convex, coarsely pustulose, ventral and part of anterior margins of each valve bears a row of thick, short spines; midportion of each valve ornamented by a longitudinal, strongly elevated, blunt, cleatlike ridge set on a constricted base; ridge attains about $\frac{1}{2}$ length of shell. Cleats in observed specimens are solid calcite; it is unknown whether they were hollow in the living form.

Length of figured specimen 0.93 mm., height 0.63 mm., convexity excluding cleats 0.30 mm., including cleats 0.53 mm.

Remarks.—This species is distinguished by the single cleatlike ventral ridge.

Occurrence.—The species occurs rarely in the middle Decorah at St. Paul from 19–43 feet above the base, becoming common 37–39 feet above the base; at Cannon Falls it is rare 37–39 feet above the base; absent at Rochester and Sugar Creek. Kay recorded it from the Ion shale 45 feet above the top of the McGregor limestone at Ellsworth, Wisconsin.

Family Aechminidae Bouček, 1936

Carapace subelliptical to subquadrate, straight-hinged with a prominent short to long spine projecting from middorsal region; cardinal angles well marked, subequal; valves approximately equal in size; hingement simple; in some species a rounded pit lies adjacent (anterior?) to spine; and there may be marginal ridges or marginal spines (Swartz, 1936).

Geologic Range.—Ordovician-Devonian.

Genus Aechmina Jones & Holl, 1849

Straight-hinged, subelliptical, with dorsomedian spine, but without adjacent pit or marginal ridges or spines. Ordovician-Devonian.

Type species.—*Aechmina cuspidata* Jones & Holl, 1849.

Geologic Range.—Ordovician-Devonian.

Aechmina ionensis Kay
Pl. 48, figs. 2a–d

Aechmina ionensis Kay, 1940, Jour. Paleontology, v. 14, p. 261, pl. 33, figs. 31–33.

Shell subquadrate to subpyriform in side view, highest about one-third from posterior end; dorsal margin straight, nearly equal to valve length; cardinal angles distinct, the posterior about 90°, the anterior slightly greater; ventral margin moderately convex, converging with dorsum in an anterior direction; anterior border much narrower than posterior, both are curved. Valves approximately equal in size, the right a little larger, compressed, except for dorsal spine, greatest convexity of general valve surface postero-median.

A broad-based, conical spinose projection occurs adjacent to dorsal margin about one-third from posterior end; spine on left valve lies slightly forward of that on right; spines project beyond dorsal margin as seen from the side; anterior margin of right valve bears a few short spines; general surface of valves

smooth. Internal structure not seen.

Length of a figured specimen (Pl. 49, fig. 2a) 0.58 mm., height 0.36 mm., convexity excluding spines 0.20 mm.

Remarks.—According to Kay this species is more elongate and narrower than *A. richmondensis* Ulrich & Bassler (1923, p. 299) from the Richmond Elkhorn formation of Indiana.

Occurrence.—The species was found in the present collections to be rare in the middle Decorah at St. Paul, and in the upper Decorah at Cannon Falls. It was not found at Rochester or Sugar Creek. Kay (1940, p. 261) recorded it in the Ion member of the Decorah six miles south of Cannon Falls, Minnesota.

Superfamily LEPERDITELLACEA Ulrich & Bassler, 1906
Family LEPERDITELLIDAE, Ulrich & Bassler, 1906

Primitiidae ULRICH & BASSLER, 1923, Maryland Geol. Survey, Silurian, vol., p. 647.

Outline of carapace leperditioid, generally smooth-surfaced; convexity variable; middorsal surface of valves depressed or weakly sulcate; size of carapace variable but small to medium sized.

Geologic Range.—Ordovician-Permian.

Genus SCHMIDTELLA Ulrich, 1892

Carapace small, subovate, subcircular to subelliptical; dorsal margin more or less convex, umbonate, right valve slightly larger than left; hinge margin straight, short, and with weakly rabbeted articulation of valves; internal low dorsomedian ridge represents sulcus in animal; surface smooth; ventrally with submarginal furrow in some species marking position of edge of earlier molt. Ordovician-Silurian.

Type species.—*Schmidtella crassimarginata* Ulrich, 1892.

Geologic Range.—Ordovician-Silurian, Carboniferous?

SCHMIDTELLA UMBONATA Ulrich
Pl. 48, figs. 3a–e; text-figs. 2e,2g

Schmidtella umbonata ULRICH, 1894, Final Rept., Minn. Geol. and Nat. Hist. Survey, v. 3, pt. 2, p. 641, pl. 45, figs. 36–38; GRABAU & SHIMER, 1910, Index Fossils N. Am., p. 343, fig. 1656 t-r; BASSLER, 1915, U. S. Natl. Mus., Bull. 92, p. 1148; Kay, 1940, Jour. Paleontology, v. 14, p. 242, pl. 29, figs. 9–11; ELLIS & MESSINA, 1952, Catalogue of Ostracoda, Am .Mus. Nat. Hist. Special. Pub.

A characterization of the species was provided by Kay (1940, p. 242) in supplement to Ulrich's original description. Outline elongate to subelliptical, dorsum moderately arched with medially placed short umbo; anterior margin narrower than posterior; a middorsal slight subvertical depression, representing a primitive sulcus, is matched internally by a low ridge.

Length of a figured left valve (Pl. 48, fig. 3a) 0.53 mm., height 0.40 mm., thickness of valve 0.13 mm.

Remarks.—The short beaklike umbo distinguishes this species from *S. brevis* and *S. affinis* which are characterized by more broadly umbonate dorsal outlines.

Occurrence.—The species is very abundant in the lowermost 9 feet and abundant throughout much of the Decorah shale at St. Paul; abundant throughout the Decorah at Cannon Falls and Rochester; and very abundant throughout the formation at Sugar Creek, Minnesota. According to Kay (1940, p. 242) it is of frequent occurrence in the Ion member in northeastern Iowa.

SCHMIDTELLA AFFINIS Ulrich
Pl. 48, figs. 4a–c; text-fig. 2f

Schmidtella affinis ULRICH, 1894, Final Rept., Minn. Geol. and Nat. Hist. Survey, v. 3, pt. 2, p. 641, pl. 43, figs. 45–47, KAY, 1940, Jour. Paleontology, v. 14, p. 241, p. 29, figs. 1–4. (see Harris, 1957, for additional synonymy).
Schmidtella umbonata HARRIS (not Ulrich), 1931, Okla. Acad. Sci., Proc., v. 12, p. 58,59, pl. 13, figs. 9a,b, (see Harris, 1957, for additional references).

Outline suboval; dorsal margin umbonate, projecting strongly beyond short hinge; surface moderately convex; a channel parallel to free margins marks edge of an earlier instar valve; surface otherwise smooth. Additional details provided by Kay (1940).

Length of a small left valve (Pl. 48, fig. 4b) 0.70 mm., height 0.53 mm., convexity of valve 0.13 mm.

Remarks.—This species is less umbonate than *S. brevis* Ulrich but more umbonate than *S. incompta* Ulrich to which it is otherwise very similar in outline. It differs from *S. crassimarginata* Ulrich in being less deeply channeled along venter by edge of retained

instar valve than is *S. crassimarginata*.

Occurrence.—Abundant from the basal through the middle part of the Decorah shale at St. Paul; abundant throughout the Decorah at Cannon Falls; very abundant from the base nearly to the top of the Decorah at Rochester; abundant throughout the formation at Sugar Creek, Minnesota. Found in both Guttenberg and Ion members of Decorah of Iowa (Kay, 1940, p. 241). In southern Oklahoma (Harris, 1957, p. 163) the species occurs in the McLish, Tulip Creek and lower Bromide formations of the upper (Black River) portion of the Simpson Group.

SCHMIDTELLA BREVIS Ulrich
Pl. 48, figs. 5a–d

Schmidtella brevis ULRICH, 1894, Final Rept., Minn. Geol. and Nat. Hist. Survey, v. 3, pt. 2, p. 642, pl. 45, figs. 34,35; KAY, 1940, Jour. Paleontology, v. 14, p. 241, pl. 29, figs. 7,8. (see Harris, 1957 for additional synonymy)
Schmidtella circularis HARRIS, 1936, Okla. City Geol. Soc. Field Conf. Guidebook, p. 7, fig. 36.

Outline suboval, highest posteromedially; anterior margin more narrowly rounded than posterior and slightly extended below; dorsum rather strongly umbonate, surface smooth.

Length of a figured left valve (Pl. 48, fig. 5c) 0.72 mm., height 0.56 mm., thickness of valve 0.20 mm.

Remarks.—This species has a more strongly arched dorsal margin than *S. affinis* and lacks a submarginal ventral furrow on valve exterior. The umbo is broader than on *S. umbonata*. At present it is not clear whether *S. brevis* is a valid species or merely a statistical variant of *S. affinis* and *S. umbonata*.

Occurrence.—*S. brevis* occurs rarely in the middle Decorah at St. Paul; and is absent at Cannon Falls, Rochester and Sugar Creek. Kay (1940, p. 242) found it to be restricted to the Guttenberg member of the Decorah of Iowa. In southern Oklahoma (Harris, 1957, p. 165) it is abundant in the Tulip Creek formation of Black River Ordovician age.

EXPLANATION OF PLATE 47

FIG. *1*—*Bullatella granilabiata* (Ulrich). *1a*, Left side of a complete shell, 25–27 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. *1b*, Right side of a complete male? specimen. *1c*, Right side of a poorly preserved female? specimen, same locality and horizon as *b*, ×30.

2—*Bullatella granilabiata* (Ulrich)? Right side of an immature shell questionably in this species, but with strongly produced midventral valve surface, 61–63 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota, ×30.

3—*Macronotella scofieldi* Ulrich. *3a,b*, Right side and dorsal views of a complete shell, ×30, 55-58 feet above base of Decorah, Cannon Falls section, Minnesota.

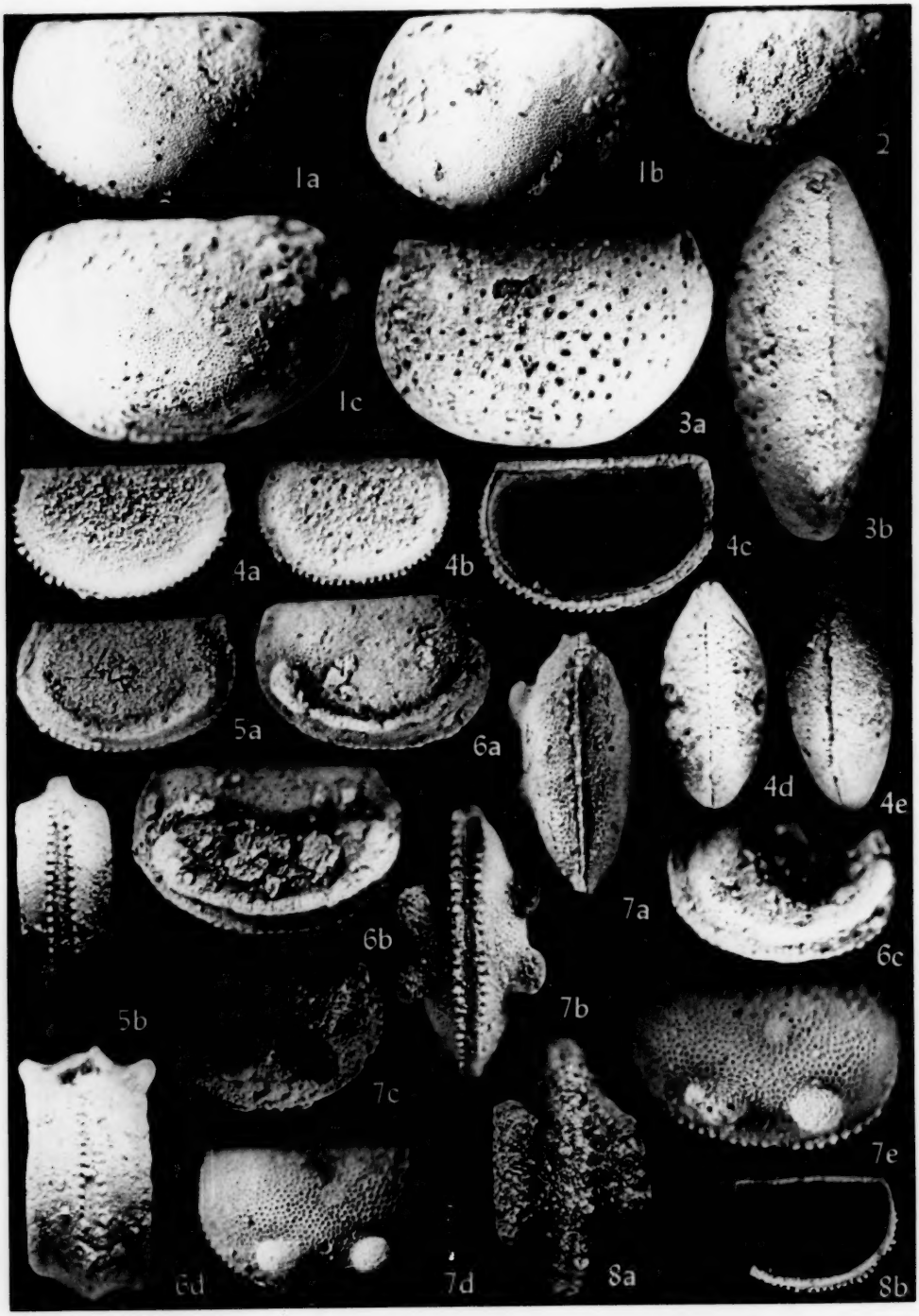
4—*Saccelatia arrecta* (Ulrich). *4a*, Right side of a whole specimen. *4b*, exterior of a left valve. *4c*, interior of left valve, ×50, 7.5–9.5 feet above base of Decorah, Cannon Falls section, Minnesota. *4d,e*, Dorsal and ventral views of a complete specimen, ×50, 13.5–15.5 feet above base of Decorah, Cannon Falls section, Minnesota.

5—*Saccelatia angularis* (Ulrich). *5a,b*, Right side and ventral views of a complete shell, ×50, 47–49 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota.

6—*Saccelatia arcuamuralis* Kay. *6a,d*, Left side and ventral views of a complete specimen, ×50. 47–49 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota, *6b,c*, Right sides of two poorly preserved specimens, ×50, 47–49 feet above base of Decorah, Cannon Falls section, Minnesota.

7—*Saccelatia bullata* Kay. *7a*, Dorsal view. *7b*. ventral view. *7c*, left-side. *7d*, right side. *7e*, right side, ×50. *a* and *e* are from 17–20 feet; *c* and *d* are from 47–49 feet; *b* is from 50–53 feet above base of Decorah, Cannon Falls section, Minnesota.

8—*Saccelatia cletifera* Kay. *8a*, ventral view of a whole, but poorly preserved specimen, ×50, 36–40 feet above base of Decorah, Cannon Falls section, Minnesota. *8b*, Interior of an immature right valve, ×50, 19–21 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota.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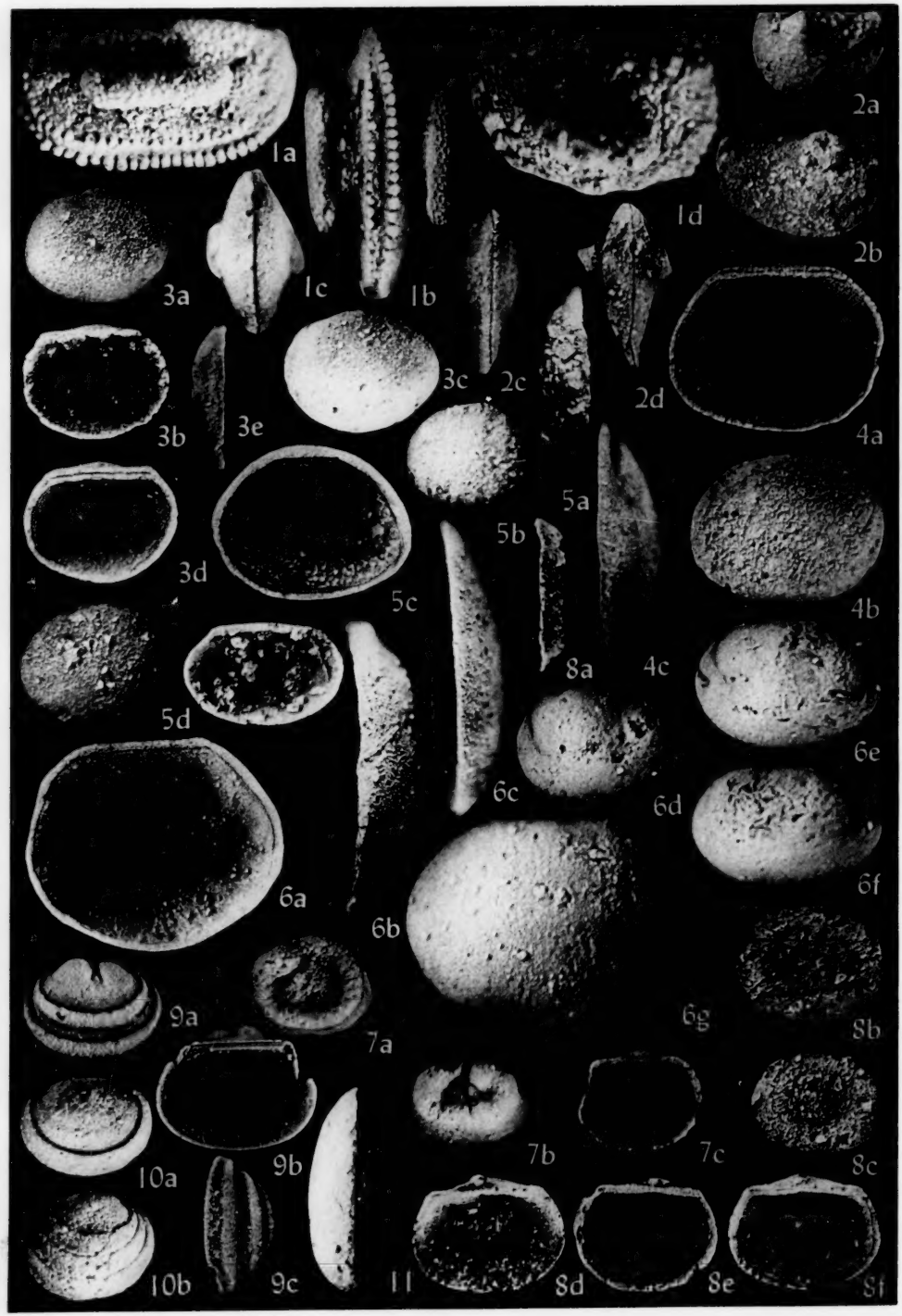
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SCHMIDTELLA INCOMPTA Ulrich
Pl. 48, figs. 6a–g

Schmidtella incompta ULRICH, 1894, Final Rept., Minn. Geol. and Nat. Hist. Surv., v. 3, pt. 2, p. 642, pl. 45, figs. 27,32,33; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 1148; BASSLER & KELLETT, 1934, Geol. Soc. Am. Special Paper 1, p. 472; Kay, 1940, Jour. Paleontology, v. 14, p. 242, pl. 29, figs. 5,6; ELLIS & MESSINA, 1952, Catalogue of Ostracoda, Am. Mus. Nat. Hist., Special Pub., v. 1.

Outline ovate-truncate, not umbonate dorsally, straight hinge about half of shell length; anterior margin more narrowly rounded than posterior and slightly extended below; it extends farther beyond end of hinge line than does posterior; a weak furrow representing free margin of earlier instar valve occurs on valve surface. It arises at cardinal angles and parallels ventral margin about $\frac{1}{3}$ distance in from that margin; anterodorsally is a slight umbonal depression, surface otherwise smooth.

Length of figured specimen (Pl. 48, fig. 6g) 1.06 mm., height 0.76 mm., thickness 0.23 mm.

Remarks.—*S. incompta* is not umbonate as are *S. affinis*, *S. brevis* and *S. umbonata*, and tends to be more elongate than those species.

EXPLANATION OF PLATE 48

FIG. *1*—*Saccelatia cletifera* Kay. *1a,b*, Left side and ventral views of a broken female? specimen. *1c*, dorsal view of a small whole specimen. *1d*, right side of a male shell. All ×50, 47–50 feet above base of Decorah, Cannon Falls section, Minnesota.

2—*Aechmina ionensis* Kay. *2a*, Right side of a complete shell, ×50, 25–27 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. *2b–d*, left side, dorsal and ventral views of a complete shell, ×50, 23–27 feet above base of Decorah, Cannon Falls section, Cannon Falls section, Minnesota.

3—*Schmidtella umbonata* Ulrich. *3a,b*, Left valve exterior and left valve interior, ×50, 3.5–5.5. feet above base of Decorah, Cannon Falls section, Minnesota. *3c,d*, Right valve exterior and right valve interior, ×50, 3.5–5.5 feet and 1.5–3.5 feet above base of Decorah, Cannon Falls section, Minnesota. *3e*, Dorsal view of left valve, ×50, 3.5–5.5 feet above base Decorah, Cannon Falls section, Minnesota.

4—*Schmidtella affinis* Ulrich. *4a*, Interior of right valve, ×50, 7.5–9.5 feet above base of Decorah, Cannon Falls section, Minnesota. *4b*, Left valve exterior, ×50, 3.5–5.5 feet above base of Decorah, Cannon Falls section, Minnesota. *4c*, Ventral view of left valve, ×50, 7.5–9.5 feet above base of Decorah, Cannon Falls section, Minnesota.

5—*Schmidtella brevis* Ulrich. *5a*, Dorsal view of right valve. *5b*, exterior of small right valve. *5c*, interior of left valve. *5d*, exterior of left valve. All ×50, 65–67 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota.

6—*Schmidtella incompta* Ulrich. *6a*, Interior of left valve. *6b*, dorsal view of right valve. *6c*, ventral view of left valve. *6d,e,f*, exterior views of small right valves showing trace of ventral edge of a former retained instar valve. *6h*, interior of immature right valve. All ×50, 77–79 feet above base of Decorah shale, Twin City Brick Plant quarry, St. Paul, Minnesota. *6g*, Exterior of left valve 69–71 feet at same locality.

7—*Pedomphalella intermedia* Swain & Cornell, n. gen., n. sp. *7a,c*, Exterior and interior views of imperfect paratype left valve, ×50, 24–28 feet above base of Decorah shale, 3 miles east of Rochester, Minnesota. *7b*, Exterior of holotype right valve, imperfect anteriorly, ×50, 20–24 feet above base of Decorah shale, Sugar Creek section near Fountain, Minnesota.

8—*Pedomphalella subovata* Swain & Cornell, n. sp. *8a*, Ventral view of left valve. *8b*, exterior of right valve. *8c*, exterior of left valve. *8d,e,f*, interior views of a right, a left and another right valve. *8d* is the holotype. All ×50, 17.5–20.5 feet above base of Decorah shale, Cannon Falls section, Minnesota.

9—*Eridoconcha marginata* (Ulrich). *9a*, Exterior of right valve. *9b*, interior of right, *9c*, ventral view of left valve. All ×50, depauperate zone of basal Maquoketa, Bellevue State Park, Iowa; illustrated for comparison with *Cryptophyllus* and to show retained molts; specimens are pyritized.

10—*Cryptophyllus oboloides* (Ulrich & Bassler). *10a*, Exterior of a right valve. *10b*, exterior of a right valve that has retained two instars. Both ×50, 17.5–20.8 feet above base of Decorah, Cannon Falls section, Minnesota.

11—*Macrocyproides trentonensis* (Ulrich). Ventral view, ×50, 3.5–5.5 feet above base of Decorah, Cannon Falls section, Minnesota.

Occurrence.—This species occurs commonly to abundantly in the upper Decorah shale at St. Paul, 65 to 89 feet above the base of the formation; it is absent in the middle Decorah and is rare to frequent in the lower Decorah, 23 to 35 feet above the base. It was not found in the Decorah at the other localities in Minnesota, but Kay (1940, p. 242) reported it in abundance from the Spechts Ferry member of the Decorah of Iowa and from the lower and middle Trenton of Ontario.

Genus PEDOMPHALELLA Swain & Cornell, n. gen.

Shell small, subovate, weakly umbonate, leperditelloid dorsomedian sulcus; with hooflike marginal broad ridge and depressed median area; interior of valve more or less evenly concave, indicating that shell wall over ridge is double and separated from inner valve layer by air-space; depressed median area may represent location of an earlier retained molt valve; hinge of right valve rabbeted and slightly overlapped by hinge edge of left.

The shape, sulcation and marginal features as well as indication of retained earlier molts are features relating this genus phylogenetically to *Cryptophyllus, Schmidtella* and similar genera.

Type species.—*Pedomphalella intermedia* Swain & Cornell, n. sp.

Geologic Range.—Middle Ordovician.

PEDOMPHALELLA INTERMIDIA Swain & Cornell, n. gen., n. sp.
Pl. 48, figs. 7a–c

Shell subovoid in lateral view, highest anteromedially; dorsal margin gently convex with short beaklike umbo; hinge margin recessed; cardinal angles distinct, the anterior only slightly obtuse, the posterior more obtuse; ventral margin moderately convex; anterior margin broadly rounded; posterior margin more narrowly rounded.

Valve surface bears a strongly elevated broad rounded ridge which is open dorsally in a sulcuslike gap, below umbonate area, and terminates anterodorsally in a bulbous node; ridge not reflected on interior surface and apparently is air filled. Hinge surface not clearly observed but in right valve apparently consists of a rabbeted groove which is overlapped by edge of left. General surface smooth.

Length of holotype (Pl. 48, fig. 7b), a right valve broken slightly along terminal margins, 0.45 mm., height 0.31 mm., convexity of valve 0.15 mm.

Relationships.—The unique marginal ridge and small sulcuslike gap in the ridge distinguish this species. The species possibly shows a phylogenetic relationship among *Eridoconcha, Schmidtella, Cryptophyllus* and *Bollia*. The general shape and umbonation are reminiscent of the first three genera while the bulbous ridge is much like that in *Bollia*. The depressed median area in *Pedomphalella intermedia* may formerly have been occupied by an immature molt valve, a feature which is a further link to *Schmidtella* and *Cryptophyllus*.

Occurrence.—Rare in Decorah shale 24–28 feet above the base at Rochester, and 20–24 feet above the base at Sugar Creek, Minnesota.

PEDOMPHALELLA SUBOVATA Swain & Cornell, n. sp.
Pl. 48, figs. 8a–f; text-fig. 2i

Shell subovoid in lateral view, highest medially; dorsal margin slightly convex, cardinal angles indistinct, approximately 120 degrees; ventral margin moderately convex; terminal margins broadly and nearly equally rounded; the anterior very slightly the narrower in some specimens. Valves moderately convex with greatest thickness dorsomedian.

A broad, rounded, submarginal ridge is present and most strongly elevated along terminal and dorsal margins; ventrally ridge is much lower and nearly disappears; antero-middorsally a small node rises from surface of marginal ridge to form beak; side of beak which faces hinge is slightly notched.

Hinge of holotype right valve a rabbet groove which is overlapped by corresponding rabbet groove on left valve. A slightly backward-trending, weak internal ridge extends downward from hingeline, anterior to midlength, marking position of median sulcus.

Length of holotype right valve (Pl. 48, fig. 8d) 0.53 mm., height, excluding beak 0.38 mm., convexity of valve 0.13 mm.

Relationships.—The dorsally developed yolklike ridge distinguishes this species. The depressed midportion of the valves may represent the position of a former immature instar valve.

Occurrence.—The species is very abundant 7 to 13 feet above the base of the Decorah, 23 to 27 feet above the base and rare to common 45 to 53 feet above the base at St. Paul; rare to common 11.4 to 20.4 feet above the base at Cannon Falls; and was not found at Rochester or Sugar Creek, Minnesota.

Genus CRYPTOPHYLLUS Levinson, 1951

Carapace ovate to subquadrate, small to medium size, umbonate; subtriangular inflation or bilobed extension above dorsum; if lobate, posterior swelling larger and higher than anterior; hinge straight, short to medium length; a short, closed sulcus or dorsomedian pit may be present; one or more wide concentric ridges parallel lower margins and tend to converge at dorsum; dimorphism present in some species; males more elongate than females.

Type species.—*Eridoconcha oboloides* Ulrich & Bassler, 1923.

Geologic Range.—Ordovician.

CRYPTOPHYLLUS OBOLOIDES (Ulrich & Bassler)

Pl. 48, figs. 10a,b

Eridoconcha oboloides ULRICH & BASSLER, 1923, Md. Geol. Survey, Silurian vol., p. 296, pl. 14, figs. 6–8; BASSLER & KELLETT, 1934, Geol. Soc. Am., Special Paper 1, p. 310; KAY, 1940, Jour. Paleontology, v. 19, p. 247, pl. 29, figs. 34,35.

Cryptophyllus oboloides (Ulrich & Bassler) LEVINSON, 1951, Jour. Paleontology, v. 25, p. 550.

Outline subtriangular to subovate, strongly umbonate dorsally in specimens retaining earlier molts, less strongly umbonate in other specimens; highest posteromedially; anterior margin a little narrower than posterior; a very weak shallow subvertical sulcus occurs at apex of dorsal umbonate area; surface in well preserved specimens with about 5 broad concentric ridges representing free marginal zones of retained instar valves; grooves separating ridges are narrow and V-shaped in cross-section.

Length of a figured right valve (Pl. 48, fig. 10b) 0.47 mm., height 0.37 mm., convexity of valve 0.20 mm.

Remarks.—This species is distinguished by general subtriangular outline, moderately pointed umbo and weak dorsal sulcus. *C. gibbosum* Harris from the upper (Black River) part of the Simpson group of Oklahoma is a closely similar if not identical species, but is larger than typical *C. oboloides* (Harris, 1957, p. 181).

Occurrence.—The species is rare to abundant beginning 27 feet above the base of the Decorah at St. Paul; common from 15.4 feet upward in the Decorah at Cannon Falls; rare from 4 feet above the base to the top, at Rochester; and rare in the lowermost and uppermost 4 feet at Sugar Creek, Minnesota. According to Kay (1940, p. 248) the species is common throughout the Decorah of Iowa.

Genus BYRSOLOPSINA Swain & Cornell, n. gen.

Valves subquadrate, dorsal margin straight to slightly convex due to weak umbonation; posterior margin more broadly rounded, but less extended beyond end of hinge than anterior; lateral surface of valves markedly flattened, in part with ridgelike expansion of ventral part of shell overhanging margin; surface finely to coarsely punctate; weak internal dorsal median ridge represents sulcus in animal; adductor muscle scar apparently a spot near lower end of internal ridge, hinge edge of right valve thin and overlaps thickened and beveled edge of left valve.

The Ordovician species are similar to *Paraschmidtella* Swartz of the Lower Devonian, but are more flattened laterally, have overhanging ridgelike marginal areas in ventral half of shell and are sulcate.

Type species.—*Paraschmidtella planilateralis* Kay, 1940.

Geologic Range.—Middle Ordovician.

BYRSOLOPSINA PLANILATERALIS (Kay)

Pl. 49, figs. 1a-i, 2a-f; text-figs. 2j,2k

Paraschmidtella planilateralis KAY, 1940, Jour. Paleontology, v. 14, p. 246, pl. 30, figs. 8–13.

Outline of valves subovate, dorsally truncate, hinge margin about two-thirds of valve length; posterior margin more broadly rounded than anterior; about 30 coarse pits on lateral valve surface; smooth marginal

area rises abruptly from valve edge; posteriorly in some specimens a low ridgelike elevation runs parallel to margin; anteroventrally in most specimens submarginal surface forms ridgelike elevation which overhangs valve margin. In edge view lateral valve surfaces markedly flattened.

Hinge surface of left valve slightly incised below level of dorsal surface of valve; at ends of hinge short weak grooves occur just beneath cardinal angles; anterior portion of hinge slightly more thickened in cardinal region than posteriorly. Hinge edge of right valve thinner than that of left and apparently slightly overlaps it. A low ridge on valve interior begins near dorsal margin about one-third distance from narrower anterior margin and extends to midheight; adductor muscle area not clearly seen but evidently is a spot near lower end of ridge.

Length of a figured left valve (Pl. 49, fig. 1a) 0.43 mm., height 0.30 mm., convexity of valve 0.10 mm.

Remarks.—*B. planilateralis* is distinguished from *B. ovata* by its compressed valve surfaces and smooth marginal area.

Occurrence.—The species is common in the middle part of the Decorah shale at St. Paul; beginning 27–29 feet above the base, where it succeeds *B. normella*, n.sp.; is frequent from 9.4 feet above the base through the remainder of the formation at Cannon Falls, is abundant in the middle and upper Decorah at Rochester; and is very abundant from 8 to 40 feet above the base of the Decorah at Sugar Creek, Minnesota. Kay (1940, p. 247) found it abundantly in the Ion member of the Decorah at Ellsworth, Wisconsin but did not find it in Iowa.

Byrosolopsina centipunctata (Kay)
Pl. 49, figs. 3a-i

Paraschmidtella centipunctata Kay, 1940, Jour. Paleontology, v. 14, p. 246, pl. 30, figs. 18–21.

Outline subovate, valves compressed, posterior margin more broadly rounded than anterior; posterior cardinal angle the less obtuse; surface with more than 100 irregularly arranged pits which are weak or absent over submedian transluscent adductor muscle area.

Length of figured right valve (Pl. 49, fig. 3a) 0.43 mm., height 0.30 mm., convexity 0.10 mm.

Remarks.—This species is distinguished by its large number of tiny surface punctations.

Occurrence.—The species is rare beginning 11–13 feet above base and is frequent in the middle Decorah at St. Paul; and is rare in the middle and upper Decorah at Cannon Falls, Minnesota.

Byrsolopsina ovata (Kay)
Pl. 49, figs. 4a-i

Punctaparchites ovatus Kay, 1934, Jour. Paleontology, v. 8, p. 332, pl. 44, fig. 5.
Paraschmidtella ovata (Kay) Kay, 1940, Jour. Paleontology; v. 14, p. 245, pl. 30, figs. 14–17.

Shell subelliptical in lateral view, highest medially to posteromedially; dorsal margin nearly straight and with moderately distinct cardinal angles of which the posterior is less obtuse than the anterior, ventral margin moderately convex in left valve, less convex in right; posterior margin broadly rounded; anterior margin a little more narrowly rounded; both are extended medially. Valves subequal, moderately and uniformly convex, greatest convexity median.

Surface ornamented by about 40 large deep pits which are about .015 mm. in diameter. In some specimens these are roughly arranged in subvertical rows which are oriented slightly in an anteroventral direction. Pits apparently connected to valve interior by means of much smaller pore canals. A slight sulcate depression visible middorsally in some specimens.

Hinge surface straight, apparently with simple contact of valves; dorsal surface of valve rises slightly above line of commissure but not as a distinct umbo. Muscle scar not clearly observed in specimens at hand.

Length of a figured left valve (Pl. 49, fig. 4b) 0.48 mm., height 0.33 mm., convexity 0.13 mm.

Remarks.—This species is clearly distinguished from *B. centipunctata* (Kay) by fewer pits and from *B. planilateralis* (Kay) by more evenly convex surface and lack of smooth marginal area.

Occurrence.—*B. ovata* is common in the upper Decorah at St. Paul and at Cannon Falls, Minnesota. According to Kay the species ranges throughout the Decorah shale of northeastern Iowa.

BYRSOLOPSINA NORMELLA Swain & Hansen, n. sp.
Pl. 49, figs. 5a-c

Shell subovate to subquadrate in side view; greatest height posteromedian; dorsal margin nearly straight, with slight median convexity; ventral margin gently convex; anterior margin narrowly rounded in mature valves, somewhat extended above; posterior margin broadly and uniformly rounded. Valves somewhat compressed laterally, greatest convexity in posterior third.

Valve surfaces except smooth marginal zone, deeply and coarsely pitted with 30–35 pits; surface rises steeply from all except anterodorsal margins; a low ridgelike swelling parallels posterior margins at posterior edge of pitted area; and a similar short subalate swelling occurs anteroventrally; in immature specimens posterior submarginal ridge overhangs margin. Subvertical alignment of surface pits occurs in some specimens, especially in anterior half. A shallow depression, possibly representing median sulcus, occurs anterodorsally in some specimens.

Length of holotype right valve (Pl. 49, fig. 5a) 0.48 mm., height 0.31 mm., convexity 0.13 mm.

Relationships.—This species is closely related to *B. planilateralis* (Kay) in its flattened pitted valve surfaces, smooth steeply inclined marginal zone and submarginal weak ridges. It differs from *B. planilateralis* in its more ovate rather than elliptical outline and compressed anterodorsal area. The valve surfaces in *B. normella* are typically less flattened than in *B. planilateralis*.

Occurrence.—Common in lower middle part of Decorah shale at St. Paul, beginning 23–25 feet above the base and extending to 27 feet above the base.

Superfamily BEYRICHIACEA Matthew, 1886
Family DREPANELLIDAE Ulrich & Bassler, 1923

"Subquadrate to subovate Ostracoda with long straight hinge, and subequal, generally well defined cardinal angles; usually with a strong ridge paralleling all or part of the free margins; primitively with swellings near the dorsomedian sulcus, the swellings sometimes forming two or more strong knobs, which may connect ventrally to form a U-shaped ridge, or may become obsolete. Hingement apparently simple; marginal overlap wanting or inconspicuous." (Swartz, 1936, p. 552.)

Genus PARENTHATIA Kay, 1940

Shell small to medium-sized, subovate to subquadrate; dorsal margin straight to convex, but hinge line straight; valves compressed; terminal and part of ventral margins with broad submarginal ridges; surface punctate; weak dorsomedian sulcus or corresponding internal low ridge; small anteromedian, low, rounded node represents probable external expression of muscle scar; hinge edge of right valve beveled and slightly overlapped by sharpened edge of left; valves subequal.

Type species.—*Moorea punctata* Ulrich, 1894.

Geologic Range.—Middle Ordovician.

PARENTHATIA PUNCTATA (Ulrich)
Pl. 49, figs. 6a-g

Moorea punctata ULRICH, 1894, Final Rept. Geol. and Nat. Hist. Surv. of Minn., v. 3, pt. 2, p. 682, pl. 43, figs. 84–88; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 838.
Parenthatia punctata (Ulrich) KAY, 1940, Jour. Paleontology, v. 14, p. 259, pl. 32, figs. 43,44.

Shell subquadrate in side view, highest anteromedially; dorsal margin nearly straight, slightly convex medially; ventral margin moderately convex; terminal margins broadly rounded, the anterior somewhat narrower and subtruncate below; convexity of valves low to moderate, with greatest convexity median.

Terminal portions of valve surface bear strongly elevated, broad ridgelike swellings parallel to margins; posteriorly, ridge typically broader and longer than anteriorly; ends of ridges merge gradually but steeply with general surface; ridges are not reflected on interior of valves and therefore represent a doubling and separation of valve walls; in some specimens faint ventral continuations of ridges occur. A small node occurs on valve surface slightly anteromedian and dorsomedian in position; it represents position of internal low ridge that formed in a shallow median sulcus in animal. General surface bears widely spaced punctae. Hinge

of left valve composed of slightly overhanging, sharpened valve edge, which fits against the beveled and faintly grooved hinge edge of right valve.

Length of a figured right valve (Pl. 49, fig. 6b) 0.51 mm., height 0.33 mm., convexity 0.13 mm.

Remarks.—This species is distinguished from *P. camerata* Kay by lack of median subvertical depression and of submedian low elevations that characterize that species. Harris (1957, p. 198) described *Euprimitia elegans* as closely related to *Moorea punctata* Ulrich.

Occurrence.—Rare to very abundant in the middle Decorah at St. Paul, 25–55 feet above the base; rare in the Upper Decorah at Cannon Falls, 40–61 feet above the base; very abundant in the Upper Decorah at Rochester, 28–32 feet above the base, and very abundant to rare in the Upper Decorah at Sugar Creek, 32–39 feet above the base. Kay found the species to be frequent, but never common, in the Ion member of the Decorah at several localities in Iowa, Wisconsin, and Minnesota. Ulrich described the species from the upper third of the Trenton shales ("*Phylloporina*" bed) at Minneapolis.

Parenthatia camerata Kay
Pl. 49, figs. 7a-e; text-fig. 2h

Parenthatia camerata Kay, 1940, Jour. Paleontology, v. 14, p. 259, pl. 32, figs. 45,46.

Shell subquadrate in side view, highest medially; dorsal margin straight to very slightly concave medially, about ¾ of shell length, with rounded cardinal marginal bends, the anterior much more obtuse than the posterior; ventral margin in general slightly convex, straightened medially, terminal margins broadly curved, the anterior extended medially, the posterior extended above. Complete shell not observed, but valves apparently are subequal, compressed.

A broad shallow slightly anteromedian sulcus extends from dorsal margin to midheight and in some specimens is slightly reflected on valve surface venterad of midheight. Terminal marginal areas provided with broad submarginal ridges. Middle part of each valve on either side of sulcus, raised as broad rounded swellings. General surface finely punctate, the interspaces about half width of punctae. Hingement formed by simple contact of valve edges. Muscle scar a small spot lying on ventral portion of internal ridgelike reflection of median sulcus.

Length of figured specimen (Pl. 49, fig. 7b) 0.78 mm., height 0.50 mm., convexity of valve 0.20 mm.

Remarks.—This ostracode is clearly sulcate. It differs from *P. punctata* in having a straighter dorsal margin and a distinct median sulcus.

Occurrence.—Rare to common in the upper Decorah at Rochester, 28–36 feet above base; rare to very abundant in the upper Decorah at Sugar Creek, 28–36 feet above base; not found at Cannon Falls or St. Paul. Kay recorded it as "one of the more common Decorah species, being represented in most faunules, particularly those from the Ion member" (1940, p. 259).

Family Eurychilinidae Ulrich & Bassler, 1923

Shell medium to large, subquadrate to subelliptical in side view; hinge margin straight but dorsal features of shell may extend beyond hinge in some genera; a dorsomedian sulcus is present and is of variable size and configuration; a rounded node typically occurs anterior to sulcus; free margin of each valve bears a broad frill, which is typically crossed by striae or furrows and is modified by a dimorphic median to anteromedian sausage-like swelling in many species. Surface variably ornamented by nodes and pits.

Geologic Range.—Ordovician.

Genus Nodambichilina Swain & Cornell, n. gen.

Shell subquadrate to subelliptical in outline; hinge margin nearly straight, about ¾ of shell length; ventral margin convex; ends broadly and about equally rounded; midportion of each valve with two large rounded dorsomedian nodes or swollen areas separated by a short vertical sulcus; free marginal zone moderately elevated as a broad ridge that extends beyond valve margins as a frill, relative convexity and width of frill is believed to be a dimorphic feature; surface of valves relatively smooth, but with reticulated marginal ridge in some forms; hinge of

right valve a long groove which widens anteriorly; hinge of left valve a corresponding ridge; muscle scar a submedially placed area in which lie numerous tiny spots; shell two-layered and apparently with vacant space between layers; interior concavity less than corresponding exterior convexity, as a result of bilamellar shell structure.

The type species was referred to *Conchoprimitia* Öpik by Kay (1940, p. 248) but that genus lacks a frill and nodose dorsomedian swellings that led Ulrich originally to ally it with *Eurychilina*. The latter genus has a deeper median sulcus, a thinner frill and more strongly ornamented surface than the new genus.

Type species.—*Eurychilina symmetrica* Ulrich, 1894.

Geologic Range.—Ordovician.

NODAMBICHILINA SYMMETRICA (Ulrich)
Pl. 50, figs. 1a-g; text-figs. 2n,2p

Eurychilina? symmetrica ULRICH, 1894, Final Rept., Geol. and Nat. Hist. Surv. Minn., v. 3, pt. 2, p. 663, pl. 44, figs. 5–7, pl. 45, figs. 4–6; HESSLAND, 1949, Bull. Geol. Inst. Uppsala, v. 33, p. 237; HENNINGSMOEN, 1953, Norsk. geol. tidsskr., v. 31, p. 253.

Conchoprimitia symmetrica (Ulrich) KAY, 1940, Jour. Paleontology, v. 14, no. 3, p. 248, pl. 30, figs. 28–32.

Shell subquadrate-elliptical, highest medially, dorsal margin slightly convex, sinuous, with distinct, equally obtuse cardinal angles; ventral margin moderately convex, merging gradually with broadly rounded posterior end and more abruptly with equally rounded anterior end; anterior slightly extended below; complete carapace not seen, but valves apparently subequal, compressed, greatest convexity anterodorsal.

Middorsal portion of each valve bears two large rounded partly coalescing nodes, the more posterior of which is slightly elongated parallel to dorsum, compared to the other; a short anteromedian sulcus occupies ventral slope of saddle that separates nodes. Free margins bear, along venter, a broad ridge-like elevation which is strongly elevated and angulated posteroventrally and less strongly elevated anteroventrally; marginal rim narrows and drops abruptly in elevation as it approaches cardinal angles; surface of ridge in well preserved specimens ornamented by a unique pattern of pits which are considerably elongated parallel to margin of valve. Surface otherwise smooth. Marginal ridge forms a frill which extends strongly beyond ventral margin of valve; frill is relatively broad and troughlike, beneath, in some specimens possibly female dimorphs. Underside of frill bears a few transverse marks in some specimens.

Hinge edge of right valve contains a long groove which is distinctly constricted medially and is a trifle broader anteriorly than posteriorly; hinge of left valve a corresponding ridge. Muscle scar a slightly anteromedian, depressed rounded spot that apparently is composed of numerous tiny spots; in well preserved specimens a row of tiny pits outlines muscle scar area on exterior of valve.

Length of figured left valve (Pl. 50, fig. 1f) 1.65 mm., height 1.06 mm., thickness of valve 0.26 mm.

Convexity relationships of interior and exterior of valve indicates that it is two-layered and there apparently is an appreciable gap between the layers in the regions of the nodes and the frill.

Remarks.—Features of the shell were described in somewhat different terms by Ulrich and by Kay. There is no question about the identity of the specimens described here with Ulrich's material. Kay's figures (1940, p. 30, figs. 28–32) show very low or no nodes, narrow frill and subdued posteroventral elevation of the marginal rim. These may represent mainly male or immature specimens. The writer agrees with Kay that the species is dimorphic despite Hessland's (1949, p. 237) denial of it.

Occurrence.—The species is a good indicator of the middle and upper Decorah. It is rare to frequent in the middle Decorah at St. Paul; rare in the middle and upper Decorah at Cannon Falls; rare in the upper Decorah at Rochester; and rare in the middle and upper Decorah at Sugar Creek, Minnesota. Kay (1940, p. 249) found the species abundantly in the upper Decorah at Ellsworth, Wisconsin, and at several localities in northeastern Iowa.

Genus TSITRELLA Sarv, 1959

Tsitrella SARV, 1959, Akad. Nauk Est., SSR, Trudy Inst. Geol. v. 4, p. 179.

Shell small to medium-sized; truncated

oval form with more elevated posterior end; valves compressed, equal. A narrow, very short groove developed in anterior dorsal part of valve. In some specimens a very low marginal rim developed along free margins of valves. Surface of valves reticulated.

Type species.—*T. lamina* Sarv 1959.

Geologic range.—Lower and Middle Ordovician.

Remarks.—Representatives of *Tsitrella* are similar to *Primitiella* Ulrich, but differ from the latter in having flat or in some cases concave valves, in lacking the small tubercle in front of the middle groove, and in having a low marginal rim along the free margins.

TSITRELLA SIMPLEX Swain & Hansen, n. sp.
Pl. 50, figs. 2 a-f

Shell subelliptical to subquadrate in side view, highest anteriorly; dorsal margin nearly straight to slightly concave medially; cardinal areas curved, the anterior much more obtuse than the posterior, which is nearly a right angle; ventral margin mod-

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EXPLANATION OF PLATE 49

FIG. *1*—*Byrsolopsina planilateralis* (Kay). *1a*, Exterior of left valve, 37–39 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. *1b*, Exterior of right valve, 43–45 feet, same locality. *1c*, interior of a left valve, 36–40 feet above base of Decorah, Cannon Falls section, Minnesota. *1d,e*, Exterior of recrystallized right and left valves, same locality and horizon as *1c*. *1f,g*, Exterior views of two left valves, same locality and horizon as *1a* (reversed in plate). *1h*, Ventral view of right valve, 9.5–11.5 feet above base of Decorah, Cannon Falls section, Minnesota. *1i*, Interior of right valve, 40.2–43.5 feet above base of Decorah, Cannon Falls. All ×50.

2—*Byrsolopsina planilateralis* (Kay). *2a,b*, Exterior views of two right valves, 37–39 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. *2c*, Exterior of a left valve, same locality. *2d*, Interior of small left valve, 81–83 feet above base of Decorah, Twin City Brick Plant quarry. *2e*, Exterior of small left valve, same locality and horizon as *2d*. *2f*, Ventral view of specimen from same locality and horizon as *2d*. All ×50.

3—*Byrsolopsina centipunctata* (Kay). *3a*, Exterior of right valve, 36–40 feet above base of Decorah, Cannon Falls section, Minnesota. *3b*, Exterior of small right valve, 23–27 feet above base of Decorah, same locality as *3a*. *3c*, Interior of left valve, same locality and horizon as *3b*. *3d,e*, Interior of two left valves, same locality and horizon as *3b*. *3g*, Exterior of small right valve, 81–83 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. *3h*, Dorsal view of right valve, same locality and horizon as *3b*. *3i*, Interior of right valve, same locality and horizon as *3b*. All ×50.

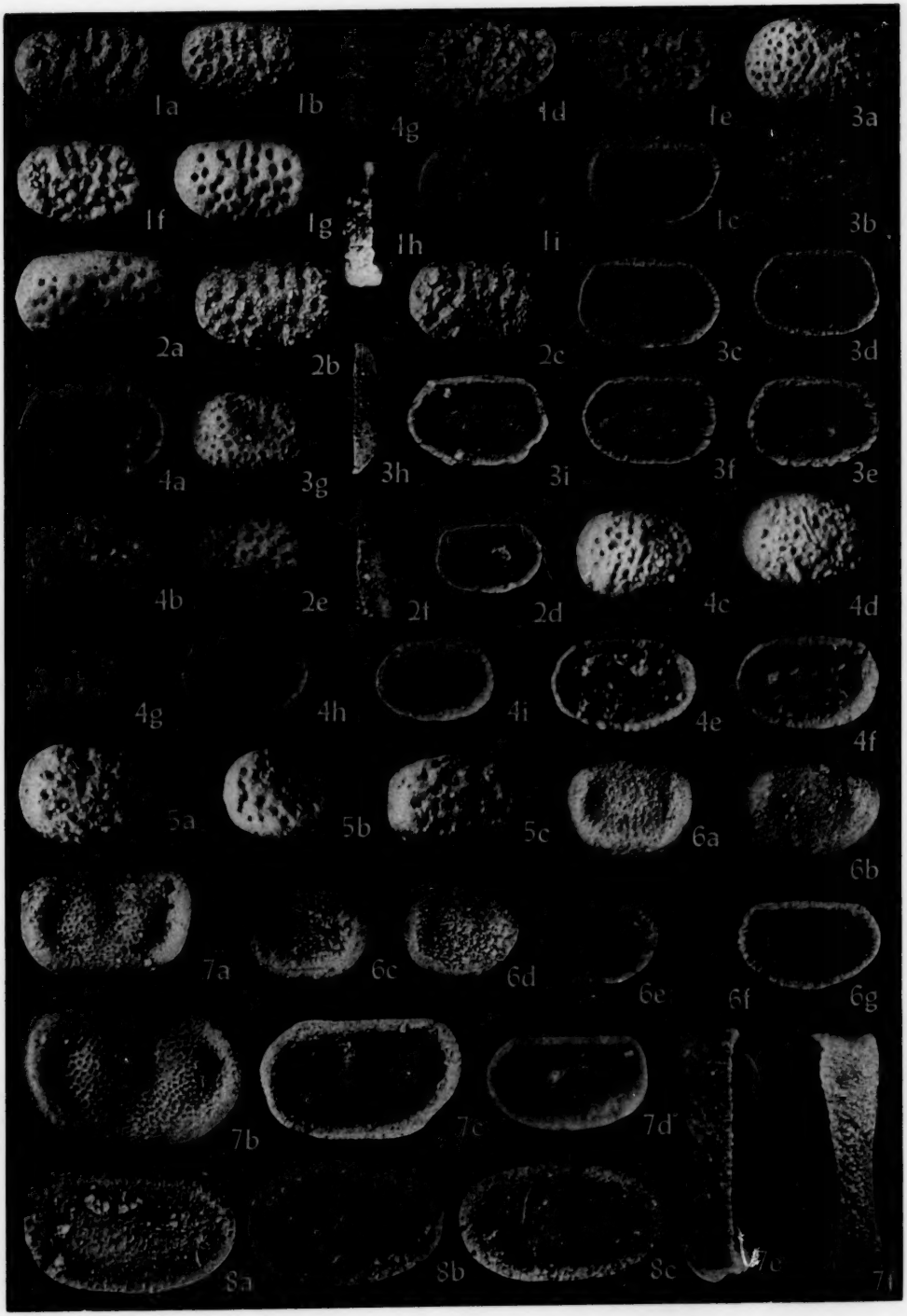
4—*Byrsolopsina ovata* (Kay). *4a*, Interior of right valve, 81–83 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. *4b*, Exterior of right valve, same locality and horizon as *3a*. *4c,d*, Exterior views of two right valves, 67–69 feet above base of Decorah, same locality as *3a*. *4e,f*, Interior views of a left and a right valve, same locality and horizon as *3c*. *4g*, Exterior of a small left valve, same locality and horizon as *3a*. *4h,i*, Interior views of a left and a right valve, same locality and horizon as *3a*. All ×50.

5—*Byrsolopsina normella* Swain & Hansen, n. sp. *5a*, Exterior of holotype right valve; *5b*, small paratype right valve; *5c*, paratype right valve, 23–25 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnnesota. All ×50.

6—*Parenthatia punctata* (Ulrich). *6a*, Exterior of left valve, either immature molt or male, 46.8–49.1 feet above base of Decorah shale, Cannon Falls section, Minnesota. *6b*, Exterior of female? right valve, same locality and horizon as preceding. *6c*, Exterior of small left valve, 28–32 feet above base of Decorah 3 miles east of Rochester, Minnesota. *6d*, Exterior of small right valve, same locality and horizon as *6c*. *6e*, Interior of small left valve, same as *6c*. *6f*, Dorsal view of right valve, same as *6c*. *6g*, Interior of left valve, same locality and horizon as *6a*. All ×50.

7—*Parenthatia camerata* Kay. *7a*, Exterior of small left valve. *7b*, exterior of right valve. *7c*, interior of right valve. *7d,e*, dorsal and ventral views of a left valve, 32–36 feet above base of Decorah, Sugar Creek section near Fountain, Minnesota. All ×50.

8—*Tsitrella simplex* Swain & Hansen, n. sp. *8a,b*, exteriors of two small left valves, 17–20 feet above base of Decorah shale. *8c*, exterior of small right valve, 46–49 feet above base of Decorah, Cannon Falls, Minnesota. All ×50.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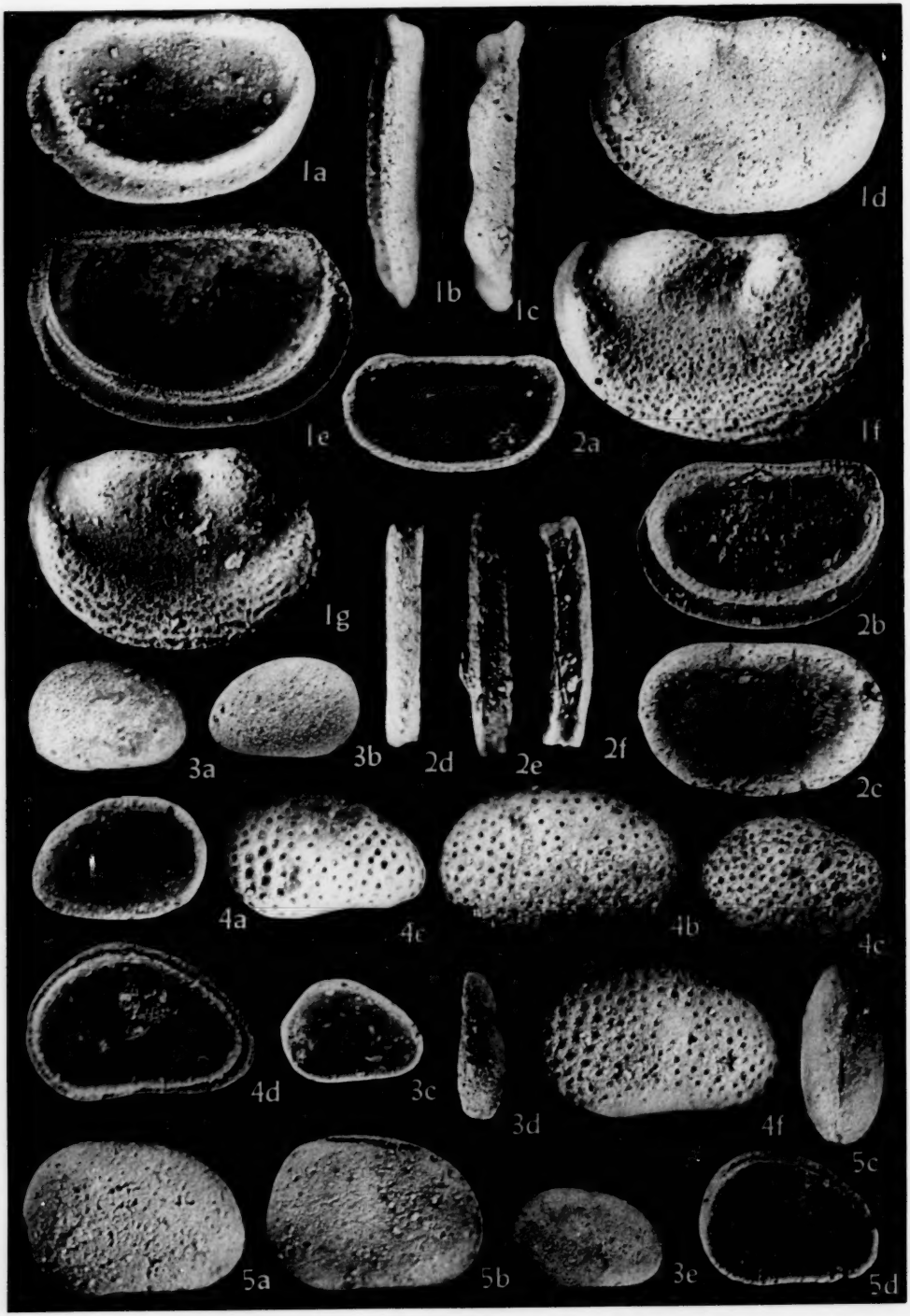
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erately convex; anterior margin broadly rounded, extended medially; curvature of posterior margin somewhat narrower, extended above. Valves subequal, compressed.

A low marginal ridge extends around entire periphery of each valve; ventral two-thirds of marginal area extended as a velum beyond free margin; in interior view, under surface of velum is somewhat concave but its edge does not extend into plane of valve contact. General surface of valve smooth or with scattered pits. Hinge edge of right valve slightly grooved for reception of edge of left. Middorsally and a little anteriorad of midlength interior valve surface bears an indistinct broad ridge not extending to mid-height; this evidently represents a median sulcus in animal which is not reflected on exterior valve surface. Muscle scar a rounded spot with obscure markings, located on internal ridge.

Length of holotype right valve (Pl. 50, fig. 2b) 0.88 mm., height 0.58 mm., convexity of valve 0.13 mm.

Relationships.—In general shape, possession of marginal frill and internal evidence of sulcation, this species is allied to *Nodambichilina;* but in its depressed valve surface and marginal rim it seems more closely related to *Tsitrella.* It is possible *T. simplex* may represent immature molts of *Nodambichilina,* but the two forms are so strikingly different that they are separated here.

A close relationship also exists between the present species and *Parenthatia,* particularly *P. camerata* Kay, in general shape, marginal rim and median sulcation. In *Parenthatia,* however, the rimlike swelling is restricted to the free margins and a marginal frill is not present. The writers suggest a possible evolutionary relationship between *Parenthatia, Tsitrella* and *Nodambichilina,* based on their structural similarities.

Occurrence.—The species is rare to common in the Decorah shale at St. Paul from 47–57 feet above the base; rare in the Decorah shale at Cannon Falls from 17.5 to 49.5 feet above the base.

EXPLANATION OF PLATE 50

FIG. *1*—*Nodambichilina symmetrica* (Ulrich). *1a,* Interior of right valve. *1b,c,* dorsal and ventral views of left valve. *1d,* exterior of left valve. *1e,* interior of left valve. *a,* 23–27 feet, *b,c,d,* 36–40 feet, *e,* 46.8–49 feet above base of Decorah, Cannon Falls section, Minnesota. *1f,* Exterior of large left valve, 47–49 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. *1g,* Exterior of left valve, 51–53 feet above base of Decorah, same locality as *1f.* All ×30.

2—*Tsitrella simplex* Swain & Hansen, n. sp. *2a,* Interior of immature right valve, 46.8–49.1 feet above base of Decorah, Cannon Falls section, Minnesota. *2b,* Interior of mature right valve, 20.8–23.1 feet above base of Decorah, Cannon Falls. *2c,* Exterior of right valve, same locality and horizon as *2a. 2d,* Dorsal view of left valve, same as *2a; 2e,* ventral view of right valve, same as *2a. 2f,* Ventral view of left valve, same as *2b.* All ×50.

3—*Punctaparchites multipunctata* (Kay). *3a,b,* Exterior views of right and left valves, 27–28 feet above base of Decorah, Sugar Creek section near Fountain, Minnesota. *3c,* Interior of left valve, 33–35 feet above base of Decorah, Twin City Brick Plant quarry, St. Paul, Minnesota. *3d,* Ventral view of left valve, broken anteriorly, same locality and horizon as *3c. 3e,* Exterior of right valve, same locality and horizon as *3a.* All ×50.

4—*Punctaparchites rugosus* (Jones). *4a,c,* Interior and exterior views of small right valve, 40–44 feet above base of Decorah, Sugar Creek, section near Fountain, Minnesota. *4b,* Exterior of right valve, same locality and horizon as *4a. 4d,* Interior of left valve, 23–27 feet above base of Decorah, Cannon Falls section, Minnesota. *4e,f,* Exterior views of two right valves, 49–53 and 53–55 feet above base of Decorah, Cannon Falls. All ×50.

5—*Macrocyproides trentonensis* (Ulrich). *5a,* Exterior of right valve, 1.5–3.5 feet above base of Decorah, Cannon Falls section, Minnesota. *5b,* Right side of complete shell, same as *5a. 5c,* Ventral view of a complete shell, 3.5–5.5 feet above base of Decorah, Cannon Falls. *5d,* Interior of left valve showing weak dorsomedian sulcus, 5.5–7.5 feet above base of Decorah, Cannon Falls section, Minnesota. All ×50.

Superfamily CYTHERACEA Baird, 1850
Family PUNCTAPARCHITIDAE Swain, Cornell & Hansen, n. fam.

Small subovate to subreniform Ostracoda, in which the greatest height is posteromedian; dorsal margin strongly convex; ventral margin nearly straight; anterior margin more narrowly rounded than posterior, extended below; posterior margin extended medially or ventro-medially, truncate below. Surface smooth or punctate. Hingement simple, consisting of a groove in one valve, generally the right, into which fits edge of opposite valve. Midventral margin has slight inward curvature, typical of podocopids. A weak anterodorsal median ridge represents position of sulcus in animal. Muscle scar a rounded spot made up of many other spots, and located near median ridge. Ordovician.

Genus PUNCTAPARCHITES Kay, 1934

Shell small to medium-sized, subovate in side view, highest in posterior half; dorsal margin strongly convex with steep posterior, and gentler anterior slope; ventral margin slightly concave; posterior margin broadly rounded; anterior margin much more narrowly rounded, strongly extended below. Valves not strongly convex; complete shell not seen but right valve is believed to be larger and to extend beyond left. Surface smooth or punctate. Articulation of valves consists of a grooved right valve into which fits edge of left; midventrally, edges of valves turned inward in a typical podocopid fashion. Muscle scar a rounded dorsomedian spot. Ordovician, central United States.

PUNCTAPARCHITES MULTIPUNCTATA (Kay)
Pl. 50, figs. 3a-e

Macronotella multipunctata Kay, 1940, Jour. Paleontology v. 14, p. 245, pl. 30, figs. 1–3.

Shell small to medium sized, highest posteromedially; short-subovate in side view; dorsal margin strongly convex, with steep posterior slope and much gentler anterior slope; ventral margin nearly straight; anterior margin narrowly rounded, strongly extended submedially, truncate below in some specimens. Valves rather compressed, greatest convexity in posterior half. Right valve slightly larger than left as judged from appearance of margins of separated valves; middorsally left valve edge weakly grooved for reception of edge of right, and overlaps right slightly in that area. Surface finely and closely punctate. A low ridgelike swelling occurs middorsally on interior of valve and apparently represents position of median sulcus in animal. Muscle scar a small circular pit containing many obscure markings, located on middorsal swelling.

Length of figured left valve (Pl. 50, fig. 3b) 0.53 mm., height 0.36 mm., convexity of valve 0.13 mm.

Remarks.—The surface ornamentation of this species is much finer than that of *P. rugosus* and that species is larger. Kay noted a striking similarity between *P. multipunctata* and *Macronotella elongata* Teichert from the Ordovician of Greenland.

Occurrence.—Rare throughout the lower and middle Decorah at St. Paul, from 1 to 67 feet above the base; rare to frequent from 1.5 to 49.5 feet above the base of the Decorah at Cannon Falls; from the base to 40 feet above the base of the Decorah at Sugar Creek. Kay described the species as common in the Guttenberg member of the Decorah of northeastern Iowa, and rare in the Ion member in Iowa and Minnesota.

PUNCTAPARCHITES RUGOSUS (Jones)
Pl. 50, figs. 4a-f; text-fig. 2m.

Cytheropsis rugosa JONES, 1858, Ann. Mag. Nat. Hist., ser. 3, v. 1, p. 254, pl. 10, fig. 51, 1858 Geol. Survey Canada, dec. 3, p. 100.
Primitia rugosa (Jones) JONES & HOLL, 1868, Ann. Mag. Nat. Hist., ser. 4, v. 2, p. 55.
Cytherella? rugosa (Jones) JONES, 1891, Geol. Survey Canada, Contr. Can. Micro-paleo., pt. 3, p. 99; ULRICH, 1894, Final Rept., Geol. and Nat. Hist. Surv., Minn., v. 3, pt. 2, p. 686, pl. 43, figs. 21–25; GRABAU & SHIMER 1910, N. Am. Index Foss., p. 366, text fig. 1666 t,u,; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 363.
Bythocypris arcta (Ulrich) HARRIS, 1931, Okla. Acad. Sci. Proc., v. 12, p. 58, pl. 13, fig. 8.
Punctaparchites rugosus (Jones) KAY 1934, Jour. Paleontology, v. 8, p. 331, pl. 44, figs. 1–4; HARRIS, 1957, Okla. Geol. Survey Bull. 75, p. 262, p. 15a,b,16.
Bythocypris seminalis HARRIS, 1936, Okla. City Geol. Soc., Field Conf. Guidebook, p. 7, fig. 17.
Leperditella seminalis HARRIS, 1937, Okla. City Geol. Soc. Field Conf. Guidebook, p. 4, 5, fig. 41.
Macronotella rugosa (Jones), KAY, 1940, Jour. Paleontology, v. 14, p. 245, pl. 30, figs. 5,6;

SHIMER & SHROCK, Index Foss. N. Am., p. 665, pl. 280, fig. 41.

Shell ovate-subreniform to subtriangular in side view, highest posteromedially; dorsal margin strongly convex in left valve, less convex in right; ventral margin slightly concave; anterior margin narrowly rounded strongly extended below; posterior margin broadly rounded, extended medially. Right valve slightly larger than left, over-reaching it ventrally. Valves not strongly convex, greatest convexity median.

Surface of valves rises steeply from posterior margin and somewhat less so from anterior margin; general surface coarsely and deeply pitted, with interstices between pits approximately equal to diameter of pits in some specimens, but up to 2× diameter of pits in other specimens. Along hinge surface, edge of right valve grooved for reception of edge of left. Details of muscle scar not observed, but smooth spot on exterior anteromedian surface apparently represents scar. There is little or no evidence of pits on valve interior, so it is not clear whether they are situated over normal canals through shell.

Length of a figured right valve (Pl. 50, fig. 4f) 0.88 mm., height 0.56 mm., convexity 0.20 mm.

Remarks.—The species is characterized by its reniform to subtriangular outline and punctate surface. There is so much individual variation that dimorphism is difficult to recognize if present. Possible dimorphism is evidenced by the variety *Punctaparchites rugosus arcta* which is relatively more elongate than typical for the species.

Occurrence.—The species is rare throughout the Decorah at St. Paul; rare to frequent from 1.5–49.5 feet above the base of the Decorah at Cannon Falls; common to abundant throughout the Decorah at Sugar Creek, Minnesota. It was not found in the Decorah at Rochester. Kay (1940, p. 245) recorded it as common in the Guttenberg and Ion members of the Decorah of northeastern Iowa and (Kay, 1934, p. 332) from the Hull formation of Ontario. Jones (1858) described it from the Leray limestone (Black River) at Pauquette's Rapids, Ottawa River, Canada and Ulrich (1894, p. 686) from the Prosser member of the Galena formation at Cannon Falls, Minnesota. According to Harris (1957, p. 263) it is common in the Bromide formation, upper Simpson group of Oklahoma.

Genus MACROCYPROIDES Spivey

Shell subovate in side view, highest anteromedially, dorsal margin strongly convex, sloping steeply behind and much more gently in front; ventral margin nearly straight; anterior margin narrowly rounded, extended to bluntly angulated below; posterior margin much more broadly rounded, typically extended above, truncate below. Right valve larger than left, but posterodorsally, edge of left valve over-reaches right. Valves moderately convex. Surface smooth. Hinge simple.

Type species.—*M. clermontensis* Spivey.

Geologic range.—Middle and Upper Ordovician.

MACROCYPROIDES TRENTONENSIS (Ulrich)

Pl. 48, fig. 11; Pl. 50, figs. 5a-d; text-fig. 21

Aparchites minutissimus trentonensis ULRICH, 1894, Final Rept. Geol. and Nat. Hist. Surv. of Minn., v. 3, p. 646, pl. 43, figs. 18–20; BASSLER, 1915, U. S. Natl. Mus. Bull. 92, p. 54; BASSLER & KELLETT, 1934, Geol. Soc. Am. Special Paper 1, p. 159; Spivey, 1939, Jour. Paleontology, v. 13, p. 165, pl. 21, figs. 26,27.

Aparchites trentonensis KAY, 1940, Jour. Paleontology, v. 14, p. 244, pl. 29, fig. 33.

Shell subpyriform to subovate in side view, highest in posterior half; dorsal margin strongly convex; ventral margin nearly straight, slightly concave medially; anterior margin narrowly rounded, extended below; posterior margin broadly rounded, subtruncate medially. Right valve a little larger than left, extending beyond it posteriorly and ventrally, dorsally left valve extends beyond right. Along venter left valve is strongly overlapped by right. Surface smooth.

Hingement simple, edge of left valve fits over that of right. A low subvertical ridge occurs anteromiddorsally on interiors of valves and probably represents median sulcus in animal; on some specimens there is an external slight groove corresponding to ridge. Muscle scar a small group of spots situated near ventral end of ridge.

Length of figured specimen (Pl. 50, fig. 5b) 0.76 mm., height 0.56 mm., convexity 0.33 mm.

Remarks.—The orientation of the genus is governed by the position of the median sulcus and muscle scar which lie toward the strongly arched and narrower margins. The revised orientation allies the species to *Macrocyproides* Spivey rather than to *Aparchites* Jones. *M. trentonensis* is not so short and high as *M. clermontensis* Spivey of the Maquoketa.

Occurrence.—The species is common from the base to 81 feet above the base of the Decorah shale at St. Paul; common throughout the Decorah at Cannon Falls; rare to frequent throughout the Decorah at Rochester; and frequent from 8 to 28 feet about the base of the Decorah at Sugar Creek, Minnesota. Kay (1940, p. 244) recorded it as persistent and frequent in both the Guttenberg and Ion members in Iowa and southern Minnesota. Spivey (1939, p. 165) found it rarely in the lower Maquoketa at Graf, Iowa.

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NAUTILOIDS FROM THE GORMAN AND HONEYCUT OF CENTRAL TEXAS

A. G. UNKLESBAY
University of Missouri, Columbia

ABSTRACT—This paper presents descriptions of six species of nautiloids from the Honeycut and one from the Gorman of central Texas. Of these six, four are known from the Jefferson City of Missouri, and two from the Cotter-Powell. The Gorman species is also known from the Gasconade of Missouri. One new species, *Stylocyrtoceras annulatum*, is described from the Honeycut.

INTRODUCTION

THE collections of the U. S. Geological Survey and the Texas Bureau of Economic Geology contain previously undescribed nautiloids from the Honeycut and Gorman formations of central Texas. Some specimens from these beds were mentioned or illustrated by Cloud & Barnes (1948) but they made no attempt at a systematic study of the fauna. The nautiloids from the Tanyard formation have been previously described (Unklesbay, 1954).

The nautiloids of the Gorman and Honeycut are preserved in chert, mostly as internal molds, and the preservation is, in most cases, very poor. However, much of the material is identifiable and reveals many significant characteristics by which the genera and species can be recognized.

Arrangments for the study of this material have been made through the courtesy of Preston E. Cloud, Jr., of the U. S. Geological Survey, Virgil Barnes of the Texas Bureau of Economic Geology, and the late Josiah Bridge, who was very much interested in this fauna. The assistance of these three men is greatly appreciated. The study was begun under the sponsorship of the University of Missouri Research Council, and was financially aided by Research Council grant number 434.

STRATIGRAPHY

The details of the stratigraphy of the Gorman and Honeycut formations have been admirably treated by Cloud & Barnes in their study of the Ellenburger (1948), and the presently described nautiloids confirm their age determinations for these beds. Of the seven species here described, four have been previously known from the Jefferson City of Missouri, and two from the Cotter-Powell units. The one Gorman species is also known from the Gasconade formation of Missouri. One new species, *Stylocyrtoceras annulatum*, is described from the Honeycut, and the only other congeneric species known is from the Jefferson City formation.

SYSTEMATIC DESCRIPTIONS

Order ELLESMEROCERATIDA Flower
Family CYCLOSTOMICERATIDAE Ulrich, Foerste, Miller & Furnish
Genus STYLOCYRTOCERAS Ulrich, Foerste, Miller & Unklesbay, 1944
STYLOCYRTOCERAS ANNULATUM Unklesbay, n. sp.
Pl. 51, figs. 12–14

Two specimens from the same locality form the basis for this species. Both are preserved in chert. They are long, slender, very gradually expanding orad, circular in cross-section, and slightly curved exogastrically. The living chamber in both is relatively long, and both are annulated.

The larger one is an external mold of a short adoral portion of a phragmacone, and of a long living chamber. The adoral part of the mold is occupied by an internal mold of part of the living chamber. The chambered portion of the specimen is about 5 mm. long and the living chamber is about 65 mm. Near the midlength of the living chamber the diameter is 5 mm. The other syntype is from a separate piece of chert, but it can be fitted into the midlength of the larger specimen as though it belonged there. It is 28 mm. long, of which about 3.8 mm. is occupied by three camerae.

On both specimens the annulations are directly transverse and the crests are about 2.5 to 3 mm. apart. The septa are shallow,

convex apicad, and closely spaced. The sutures are parallel to the annulations and are essentially straight.

The siphuncle is exogastric, and is nearly in contact with the ventral wall. It is small and at the adapical end of the smaller specimen is about 0.7 mm. in diameter. The septal necks seem to have been very slightly curved and appear to have been holochoanitic.

Another conspecific specimen from a different locality is 24 mm. long and is about half living chamber.

Remarks.—The only other species in this genus is *S. avaense* Ulrich, Foerste, Miller & Unklesbay. It differs in that it is not annulated and is slightly smaller in size.

Occurrence.—The syntypes are from the Honeycut formation 3.5 miles southwest of Cypress Mill in the Johnson City area, Blanco Co., Texas. Texas Bureau Locality No. 16T-2-31c. The third specimen is also from the Honeycut at Backbone Ridge 2300 feet North of Longhorn Cavern, Burnet Co., Texas. Texas Bureau Locality No. 27T-9-34b.

Repository.—Texas Bureau.—BEG-34749 BEG-34750, BEG-34751.

Family BALTOCERATIDAE Kobayashi
Genus PACHENDOCERAS Ulrich & Foerste, 1936

PACHENDOCERAS CONFERTUM Ulrich, Foerste, Miller & Unklesbay
Pl. 52, fig. 10

Pachendoceras confertum ULRICH, FOERSTE, MILLER & UNKLESBAY 1944 Geol. Soc. America, Spec. Paper 58, p. 121–122 pl. 63, figs. 6,7.

A nearly complete, moderately well preserved specimen is being referred to this species. It is 68 mm. long, and about 38 mm. of it is septate. The conch is essentially straight and is gradually expanded orad, the sides diverging at an angle of approximately 10 degrees. The height increases from about 10.5 mm. near the adapical end to about 23 mm. near the adoral end, in a distance of about 50 mm.

The sutures are essentially straight, and almost directly transverse. The septa are closely spaced, there being 11 of them in a distance of 8 mm. The siphuncle is ventral in position, and is about one-fourth the height of the conch. It is filled with a solid spiculum which bears impressions of septal necks.

Remarks.—This specimen is remarkably like the holotype of this species despite the fact that they came from widely separated localities.

Occurrence.—From a "Roubidoux horizon" (Gorman) on the east side of Texas Hwy. 16, 700 feet south of Flying V Ranch, San Saba Co., Texas, U.S.G.S. Loc. TF-11a.

Repository.—USNM, 143000.

Order ENDOCERATIDA Flower
Family PROTEROCAMEROCERATIDAE Flower
Genus MCQUEENOCERAS Ulrich & Foerste, 1936

MCQUEENOCERAS JEFFERSONENSE Ulrich & Foerste
Pl. 51, figs. 1,2

McQueenoceras jeffersonense ULRICH & FOERSTE, 1936, Denison Univ. Bull., Jour. Sci. Lab., v. 30, p. 279–280, pl. 38, fig. 2.

McQueenoceras jeffersonense ULRICH, FOERSTE & MILLER, 1943, Geol. Soc. America, Spec. Paper 49, p. 143–144, pl. 68, figs. 3–12.

McQueenoceras jeffersonense CLOUD & BARNES, 1948 [1946] Univ. Texas Pub. 4621, pl. 42, fig. 34.

Two chert specimens represent this species in the collection being studied. One is a chert filling of a siphuncle about 42 mm. long. The other specimen, although not very well preserved, is worthy of consideration. This specimen about 50 mm. long, is septate throughout. At the adoral end it is oval in cross section, being compressed laterally, and is about 22 mm. wide and 27 mm. high. The siphuncle at this position is circular and is about 9 mm. in diameter. The septa are closely spaced, being about 1 mm. apart. The sutures are essentially straight and slope from the dorsal toward the ventral side.

The ventral side of this specimen is broken and reveals some interesting endosiphuncular structures. The adapical end of the siphuncle is filled with a spiculum which tapers rapidly apicad to an attenuate threadlike tip. This tip extends apicad about 12.5 mm., where it is attached to another solid filling in the siphuncle. This filling is about 12 mm. long, and has flat ends.

Remarks.—The structure of the latter specimen is mentioned elsewhere in this report in a discussion of the endosiphuncular structures.

Occurrence.—From a "Jefferson City horizon" 5.3 miles north-northeast of Cherokee on the road to Rough Creek Spring then 5000 feet due north. U.S.G.S. locality TF-71.

Repository.—USNM. 143001, 143002.

Family PILOCERATIDAE Miller
Genus ALLOPILOCERAS Ulrich & Foerste, 1936
ALLOPILOCERAS sp.
Pl. 52, fig. 9

A chert internal mold of a siphuncle from San Saba County is being referred to this genus without specific assignment. It is short, and rapidly expanded, and compressed laterally to an oval cross section. It is 23 mm. long, and at the adoral end is 19 mm. high. The ventral side is nearly straight, but the dorsal is convex. The surface bears annulations which are the impressions of septal necks. They are directly transverse, and are spaced about 2 mm. apart. At the adoral end there are traces of a septum.

Remarks.—There is very little evidence of the shell of this specimen but it seems likely that the shell was breviconic, rapidly expanded, and slightly curved. It probably also had an oval or elliptical cross section. The specimen considered closely resembles siphuncle fillings described by Ulrich, Foerste & Miller (1943).

Occurrence.—From a "Roubidoux horizon" about 5.5 miles north-northeast from Cherokee on the road to Rough Creek Spring, San Saba County, Texas. U.S.G.S. Loc. TF-61.

Repository.—USNM, 143003.

Family ENDOCERATIDAE Hyatt
Genus PARAENDOCERAS Ulrich & Foerste, 1936
PARAENDOCERAS CULLISONI Ulrich, Foerste, Miller & Unklesbay
Pl. 52, fig. 2

Paraendoceras cullisoni ULRICH, FOERSTE, MILLER & UNKLESBAY 1944 Geol. Soc. America, Spec. Paper 58, p. 125, pl. 65, figs. 4,5.

This species is represented in this collection by one chert internal mold which exhibits most of the significant specific characteristics. It is straight and slightly expanded orad. The chambered portion is about 51.5 mm. long and the living chamber preserved is about 18.3 mm. The cross-section is circular and at the adapical end of the living chamber the diameter is 16.4 mm.

The sutures are directly transverse and essentially straight, although they are very slightly sinuous and form faint dorsal and ventral saddles. The septa are moderately convex apicad and are very closely spaced, resulting in very short camerae. In the adoral end of the phragmacone, where the shell diameter is about 16 mm., there are six camerae in a space of 5 mm.

The siphuncle is ventral and marginal in position. It is moderately large and at the adoral end of the phragmacone it is 6.8 mm. wide. The spiculum is long, and nearly fills the entire siphuncle of this specimen.

Remarks.—This specimen is nearly identical with the holotype except that a smaller portion of the living chamber is present.

Occurrence.—From a "Jefferson City horizon" about 9 miles S. 40° E. of Llano courthouse, in the Honey Creek section, Llano County, Texas. U.S.G.S. Loc. TF-213.

Repository.—USNM, 143004.

Order BASSLEROCERATIDA Flower
Family BASSLEROCERATIDAE Ulrich, Foerste, Miller & Unklesbay
Genus AVAOCERAS Ulrich, Foerste, Miller & Unklesbay, 1944
AVAOCERAS ELONGATUM Ulrich, Foerste, Miller & Unklesbay
Pl. 52, fig. 3

Avaoceras elongatum ULRICH, FOERSTE, MILLER & UNKLESBAY 1944 Geol. Soc. America, Spec. Paper 58, p. 41–42, pl. 8, figs. 10–12.

The single specimen being referred to this species is a fairly well preserved chert internal mold of most of the living chamber and a considerable portion of the phragmacone. It is slightly curved exogastrically and is circular in cross-section. The living chamber is 27.5 mm. long. The preserved part of the phragmacone is 22 mm. long and consists of 14 camerae, the last one of which is shorter than the others.

The sutures are straight and directly transverse.

The siphuncle is fairly large, being about 3 mm. in diameter where exposed near the adapical end of the specimen.

Remarks.—This is the only representative of this genus in the collections from central Texas.

Occurrence.—A "lower Jefferson City horizon." By speedometer 5.3 miles north-northeast of Cherokee on the road to Rough Creek Spring, and then 5000 feet due north, San Saba County, Texas. U.S.G.S. 71.

Repository.—USNM, 143005.

Order TARPHYCERATIDA Flower
Family TARPHYCERATIDAE Hyatt
Genus TARPHYCERAS Hyatt, 1894
TARPHYCERAS CHADWICKENSE Ulrich, Foerste, Miller & Furnish
Pl. 51, fig. 11; Pl. 52, fig. 11

Tarphyceras chadwickense ULRICH, FOERSTE, MILLER & FURNISH, 1942 Geol. Soc. America, Spec. Paper 37, p. 38–39; pl. 13, fig. 1; pl. 14, figs. 1,2; pl. 27, fig. 4; pl. 36, fig. 3; pl. 37, fig. 4.

Tarphyceras cf. *T. chadwickense* CLOUD & BARNES 1948 [1946] Univ. Texas Pub. 4621 p. 117, 324.

The collections of the Texas Bureau of Economic Geology contain four specimens from two areas, and all seem to represent this species. All are preserved as silicified shell material in limestone matrix, and are natural sections approximately through the median plane of the shell.

The largest specimen has a maximum diameter of about 125 mm. The living chamber is about three-fourths of a volution in length and the last one-third of it diverges from the preceding whorl in typical tarphyceroconic fashion. At the adoral end the living chamber is 30 mm. high.

The septa are slightly convex apicad and closely spaced. Where the whorl is 11 mm. high, the septa are about 2.5 mm. apart and this spacing is uniform throughout the rest of the phragmacone.

The siphuncle is nearly ventral in position, and at the same position mentioned above, where the whorl is 11 mm. high, the siphuncle is 2 mm. in diameter and is 1 mm. from the ventral wall.

Another specimen, less well preserved, exhibits essentially the same characteristics as the one described, and two smaller ones, though very poorly preserved, seem to be conspecific.

Remarks.—Despite the poor preservation

EXPLANATION OF PLATE 51

FIGS. *1,2*—*McQueenoceras jeffersonense* Ulrich & Foerste. *1*, ventral view, ×1, of specimen with portion broken away to show spiculum and fine tube connecting it to endosiphuncular structure. USNM 143002. *2*, long endosiphuncular structure, ×1, USNM 143001, both from U.S.G.S. loc. TF-71.

3-10—Endosiphuncular structures. *3*, specimen broken to show adoral conical depression, ×2, USNM 143116, U.S.G.S. loc. TF-4. *4,5*, dorsal and lateral views of specimen, ×1, which shows markings of septal necks and sharply oblique "growth lines," USNM 143009, U.S.G.S. loc. TF-4. *6*, dorsal view, ×2, of specimen with flattened asymmetrical depression, U.S.N.M. 143117, U.S.G.S. loc. 215. *7*, ventral view, ×1, of specimen broken to show adapical tip of conical structure, also shows ridge along ventral side, USNM 143009, U.S.G.S. loc. TF-4. *8*, segment of specimen broken apicad of conical depression to show mold of small tube which extends to adapical end of structure, ×2, USNM 143011, U.S.G.S. loc. TF-4. *9*, specimen without septal markings, ×2, USNM 143118, U.S.G.S. loc. TF-4
10, dorsal view, ×1, showing large fold in the conical depression, USNM 143119, U.S.G.S. loc. TF-4.

11—*Tarphyceras chadwickense* Ulrich, Foerste, Miller & Furnish. Natural section of silicified specimen, ×1. BEG 34753, loc. 27T-9-45c.

12–14—*Stylocyrtoceras annulatum* Unklesbay, n. sp. *12*, ventral view, ×2, of specimen BEG 34751, loc. 27T-9-34B. *13*, syntype, ×1, BEG 34749, loc. 16T-2-31c. *14*, ventro-lateral view of syntype, ×1, from same locality as 13. BEG 34750.

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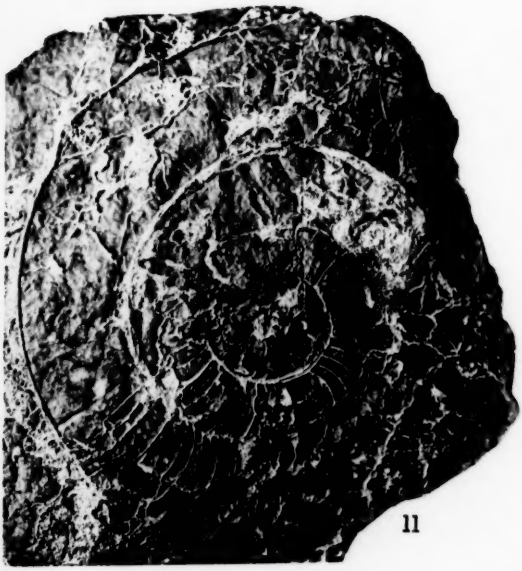
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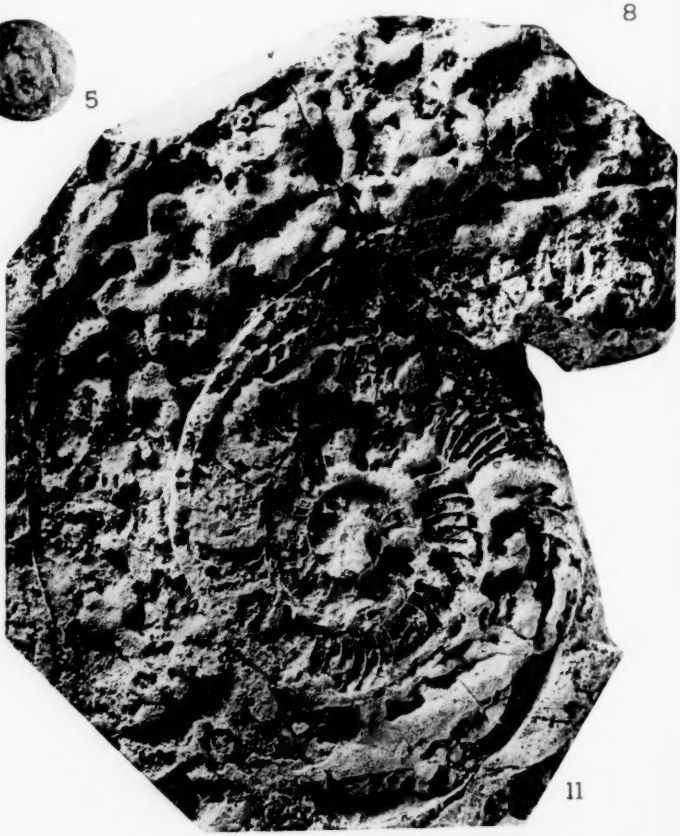

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of these specimens they are almost certainly conspecific with the holotype of this species.

Occurrence.—The large specimen described above, and the two very poor ones, come from the Honeycut formation in the Backbone Ridge area about 2½ miles southwest of Longhorn Cave in Burnet Co., Texas. The other large specimen is from bed 20 of the Roaring Spring section of Cloud & Barnes (1948). The other specimen came from 390 feet above the base of the Honeycut formation 5½ miles east of Johnson City on Stribling Ranch, Blanco Co., Texas. The two smaller ones are also from the Honeycut in the Backbone Mtn. area, Burnet County, one from 2 miles W. of Longhorn Cavern, the other 2½ miles WSW of Longhorn Cavern.

Repository.—Texas Bureau, BEG-34752, BEG-34753, BEG-34754, BEG-34755.

Genus APHETOCERAS Hyatt, 1894

APHETOCERAS SUBCOSTULATUM Ulrich, Foerste, Miller & Furnish

Pl. 52, fig. 1

Aphetoceras subcostulatum ULRICH, FOERSTE, MILLER & FURNISH 1942 Geol. Soc. America, Spec. Paper 37, p. 23–24, pl. 2, figs. 1–3; pl. 3, figs. 3–5; pl. 4, fig. 4.

The collections being studied contain one fairly well preserved specimen of this species. It is a chert internal mold of more than half of three volutions. The largest and outermost was about 90 mm. in diameter and at the adoral end was about 33 mm. high. This volution is slightly more than half living chamber, and is not in contact with the preceding one. Near the junction of the living chamber and the phragmacone the space between the whorls is about 10 mm. The whorl is nearly circular in cross-section, being only very slightly compressed laterally. The inner whorls are circular in cross-section and are coiled in close contact; however, there is no depression of the dorsal regions. No shell material is preserved but the relationship of the mold and the enclosing chert suggests that the shell must have been very thin.

The camerae are short and evenly spaced. Near the end of the phragmacone they are about 2.8 mm. long along the venter and, in an inner whorl, where the height is about 12 mm., the camerae are about 1.9 mm. long. The sutures are essentially straight and directly transverse. The septa are simple and are moderately convex apicad.

The siphuncle is ventral but not quite marginal in position. Where one of the smaller whorls is 8.2 mm. in diameter the siphuncle is about 1 mm. Near the adoral end of the phragmacone a portion of the

EXPLANATION OF PLATE 52

FIG. *1*—*Aphetoceras subcostulatum* Ulrich, Foerste, Miller & Furnish. Lateral view of internal mold in chert, ×1. USNM 143006. U.S.G.S. loc. 71.

2—*Paraendoceras cullisoni* Ulrich, Foerste, Miller & Unklesbay. Lateral view, ×1. USNM 143004. U.S.G.S. loc. TF-213.

3—*Avaoceras elongatum* Ulrich, Foerste, Miller & Unklesbay. Ventral view, ×1, USNM 143005, U.S.G.S. loc. 71.

4–8—Endosiphuncular structures. *4*, broken specimen, ×2, with quartz filling in which cone-shaped depression and small longitudinal tube is preserved. USNM 143010. *5,6*, adapical ends, ×2, of structures showing opening of small tube. *7*, lateral view of small specimen in which adoral depression is not yet developed. USNM 143007. *8*, dorsal view of small specimen in which cone has just begun, USNM 143120. All from U.S.G.S. loc. TF-4.

9—*Allopiloceras* sp. Lateral view, ×1, of internal mold. USNM 143003, U.S.G.S. loc. TF-61.

10—*Pachendoceras confertum* Ulrich, Foerste, Miller & Unklesbay. Lateral view, ×1. USNM 143000, U.S.G.S. loc. TF-11a.

11—*Tarphyceras chadwickense* Ulrich, Foerste, Miller & Furnish. Natural section, ×1. BEG 34752, loc. 27T-9-45c.

venter is broken and exposes the siphuncle. Here the conch is about 21 mm. wide and the siphuncle is about 5.5 mm. in diameter.

Remarks.—This species has not been previously reported outside Missouri, but this specimen is so close to the types of this species that it can be regarded as conspecific.

Occurrence.—The label accompanying this specimen says that it came from a "Jefferson City equivalent" 5.3 miles north-northwest of Cherokee, San Saba County, Texas. U.S.G.S. 71. However, Cloud & Barnes (1948) mention the genus *Aphetoceras* from the Honeycut at different places, and presumably this specimen is from beds that could be called Honeycut.

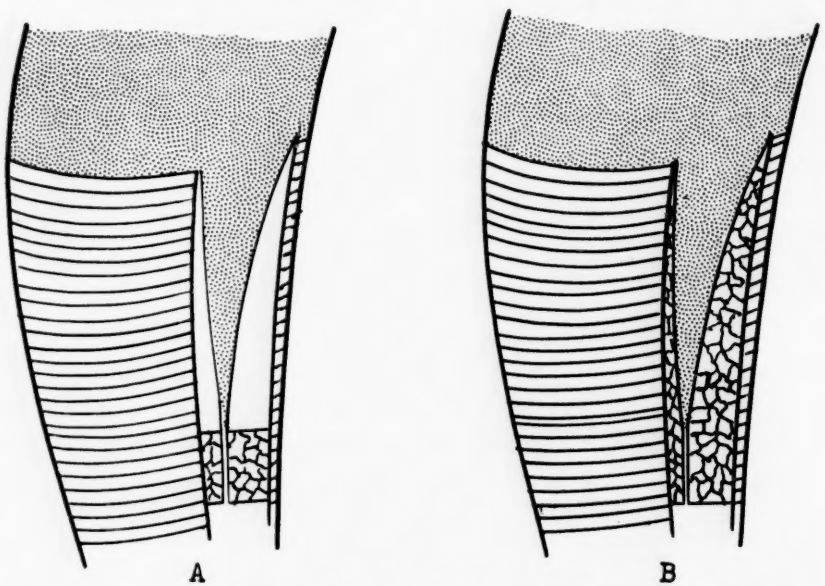
Repository.—USNM, 143006.

ENDOSIPHUNCULAR STRUCTURES

The Honeycut formation in several localities has yielded many isolated silicified internal molds of siphuncles and endosiphuncular structures. A few of these were illustrated by Cloud & Barnes. The assignment of these specimens to generic and specific categories presents a moot problem. Most of them probably belong in the genus *McQueenoceras* but this is not a certainty.

There is considerable variety among these specimens and they range from short straight cylindrical bodies with flat closed ends (Pl. 52. fig. 7), to long, curved, slightly expanding forms with flat adapical ends, but with adoral ends that form deep hollow conical depressions (Pl. 51, figs. 4,5). In some forms the conical depression is circular in cross-section and slightly asymmetrical, tapering toward the dorsal side. In others it is flattened on the ventral side and the flattening slopes from the ventral toward the dorsal side. In a few forms the ventral side of the depression is fluted or ribbed. The exterior of these specimens is relatively smooth except for annulations which mark the position of septal necks. In many specimens there is a fine ridge along the ventral side (Pl. 51, fig. 7). Some of the longer specimens bear markings which appear to be growth lines.

Broken specimens reveal an inner cavity



TEXT-FIG. *1*—Diagrammatic longitudinal section showing: *A*, a specimen in which the endosiphuncular structure has just begun and *B*, one in which the structure has grown adorally to enclose the spiculum.

which in some specimens has been filled with quartz (Pl. 52, fig. 4).

A very fine tube extends through all the short specimens (Pl. 52, figs. 5,6). In the longer ones this tube opens into the extreme adapical end of the conical depression. This tube is probably the endosiphotube of Ruedemann (1905) and Flower (1955). In broken specimens the tube is usually preserved in silica (Pl. 51, fig. 8). In some it is darkened, presumably from the presence of organic matter.

One specimen which seems to shed some light on the origin of these endosiphuncular structures is a chert internal mold referable to *McQueenoceras jeffersonense* (Pl. 51, fig. 1). In this specimen there is a filling in the adapical portion of the siphuncle and it seems to be identical with one of the isolated short endosiphuncular structures. Adorally from this structure, the siphuncle contains a tapered spiculum whose adapical end is attenuated into a fine threadlike tip which joins the flat adoral end of the cylindrical structure. This tip is in the same position as the fine tube in the free specimens. It seems very likely that if this specimen had grown to larger size this endosiphuncular structure could have grown toward the spiculum and enclosed it, thereby developing into a structure like the longer specimen with the conical depression in the adoral end. It would seem likely then that this adoral concavity in these larger specimens is the mold of the spiculum. It also seems likely that the flat ends of these structures and the tapered end of the spiculum were controlled by a diaphragm or membrane of tissue during the life of the animal.

In many respects these structures resemble the endocones of *Endoceras* but they are not built of successive solid cones.

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EVALUATION OF FOUR "NEW" LEAIID CONCHOSTRACAN GENERA

PAUL TASCH
University of Wichita, Kansas

ABSTRACT—The apparent leaiid *Monoleaia karagandica* Miro. 1956 bears a single *anterior* costa that does not cross the umbo and is therefore reassigned to the genus *Monoleiopholus*, family Estheriellidae. To accommodate estheriellids bearing one to four costa a new subfamily is proposed, Karagandiinae.

Troisleaia Miro. 1956 does not differ importantly from *Paraleaia* and is reassigned to that genus.

Teixeirium Nov. 1958 appears to be based on dubious material. If the genus bears the interpreted morphology, its preferred assignment would be under the new subfamily Karagandiinae.

Fernandoalmeidium Nov. 1958 is inadequately documented, since the inferred morphology cannot be derived from the photograph of the type specimen.

INTRODUCTION

MANY new fossil conchostracan assignments have been appearing in recent Russian literature. Careful consideration of the published evidence does not, in many instances, result in conviction that such assignments are justified. As has been discussed elsewhere (Tasch, 1956, 1958a, 1958b) and, as will be shown below, the reasons for such disagreements and doubts as do arise may largely be attributed to: (a) inadequate material (b) unwarranted subjective interpretations of the raw data. At the same time, critical evaluation of recent taxonomic assignments should not obscure the fact that our Russian colleagues have made important contributions to our knowledge of fossil clam shrimps by making known several new forms.

Genus MONOLEAIA

Miroshnichenko (Month(?), 1956) erected a new genus to accommodate a leaiid (?) conchostracan bearing an anterior rib. The new genus name used was *Monoleaia*. (The priority of *Monoleaia* Tasch, Sept., 1956, over *Inkus* Novojilov, Month (?), 1956 or vice versa has yet to be established. This solution, in turn, would bear on Miroshnichenko's use of the name *Monoleaia*.).

EVIDENCE ON THE NEW SPECIES

The new species, *M. karagandica* Miro. (*op. cit.* Pl. XVIII, figs. 3a–b, and Pl. 53, figs. 1a–b, this paper), is shown in both photograph and line drawing. As in much work on fossil conchostracans, one must carefully discriminate between the photographic evidence and interpretive reconstructions shown in drawings.

The photograph of this species (Pl. 53, fig. 1a) shows that the median sector is crushed and depressed, causing the upper portion of the posterior side of this area to appear elevated. Along the opposite side of this crushed area, toward the umbo, there is a cover of sediment. The anterior "rib" causes the growth lines crossing it to flex upwards. The dorsal margin is very straight and a fracture (?) parallels it as it approaches the umbo. Growth lines cross this parallel band. The specimen is also plainly crushed in the postero-ventral sector.

Study of the photograph leaves one puzzled because the author, in his reconstruction (Pl. 53, fig. 1b), does not show by dashed lines the absent or distorted areas. Furthermore, the configuration of the reconstruction and the idealized details shown do not correspond to the photograph. After much deliberation, one can eliminate the posterior elevation as due to crushing and hence conclude that it is not a rib. When one studies the anterior rib on the photograph, it is seen to form almost a ninety degree angle with the dorsal margin and to proceed from the sixth or seventh growth line (umbonal area) to the fourth growth line counting from the ventral margin.

In the reconstruction the umbo (not seen

on the photograph) is shown and the anterior rib proceeds from the base of the umbo to the second growth line counting from the ventral margin.

LEAIIDS AND ESTHERIELLIDS

Details such as those noted are an important consideration for the most suitable classification of this specimen. Tasch (1956, p. 1254, ex. 3) distinguished between leaiid and estheriellid conchostracans: the former having radials (ribs) that crossed the umbo and the latter with costae that become obsolete near the umbo. While it is true that estheriellids generally have more than five costae on any valve, the single "rib" is closer to an estheriellid costa than to a leaiid rib. This holds not only because it does not cross the umbo, but also because it fades out before the ventral margin is reached.

Another argument against Miroschnichenko's specimen's being a leaiid is the curious anterior position of the "rib" which he also recognized as differing from all other known single-ribbed leaiids. In the latter, the single rib is located posteriorly.

Novojilov (1958, p. 84, fig. 2) figured a species of a "new" genus, *Teixeirium rossicum*, which also has an apparent anterior rib that is flared in this instance and extends beyond the ventral margin. As will be shown below, this is based on dubious material and even if it were as shown, it would not be classed as a leaiid.

M. karagandica Miro. is placed in the family Estheriellidae. Tasch (1956, p. 1255) reached a similar conclusion for *Monoleiopholus* Ray., which also bears a single radial that does not cross the umbo.

NEW SUBFAMILY

Since known estheriellids generally bear five or more costae, it seems desirable to erect a new subfamily to embrace those with one to four costae. Although the present writer is reluctant to add new names to an already overburdened conchostracan taxonomy, it seems more economical to coin a single subfamilial name than to erect multiple genera and subfamilies to embrace each of these. The new subfamily proposed here is Karagandiinae.

NUMBER OF COSTAE, A VARIABLE FEATURE AMONG ESTHERIELLIDS

Obsolescence or nonappearance of four of the usual five costa of *Estheriella* would also result in a single anterior costa. The very fact that number of costae is a variable in estheriellid shell morphology (ranging as high as twenty or more on a given valve) and that the number can be greater than five, suggests that it can also be smaller than five.

Rarity of reports of single-costate individuals does not necessarily mean that they were in fact rare among the living population. Such features studied for large samples often show a broad spread of variability among contemporaries. Perhaps such spreads are often obscured by placing more emphasis in conchostracan taxonomy on the search for differences between specimens than on the search for similarities.

Genus MONOLEIOPHOLUS

Miroschnichenko's new genus is placed under the synonomy of *Monoleiopholus*. The rationale is as follows: a) given two or several valves having overall identity of characteristics; b) let one or more such valves have a single anterior costa while the others have a posterior one; c) then one may infer that since all valves are characterized by a single costa, this feature is generic; on the other hand, since positioning of the costa on the valve is a discriminating feature, it merits recognition on the specific level.

Thus, *Monoleiopholus conemaughensis* (Ray.) Kob., has a single posterior costa and *Monoleiopholus karagandica* (Miro.) has a single anterior costa. Both are placed under the subfamily Karagandiinae of the family Estheriellidae.

ANOTHER "NEW" GENUS

A second "new" genus erected by Miroschnichenko is *Troisleaia* (Pl. 53, fig. 2a–b) characterized by "three radial keels (ribs) spreading out from the umbo towards the ventral margin." It was thought by its author to be transitional between two- and four-keeled leaiids.

Study of the photograph (Pl. 53, fig. 2) shows that the "new" genus does not differ

importantly from the known genus *Paraleaia*. This is emphasized by the median keel. Tasch (1958b, p. 1104) noted that a median so-called "accessory" radial logically extends the definition of the paraleaiids which are characterized by a median groove or fold. Accordingly, *Troisleaia* is regarded as a synonym of *Paraleaia* Ray. 1946.

NOVOJILOV'S TWO "NEW" LEAIIDS

Novojilov (1958) described and figured two new leaiid genera: *Fernandoalmeidium* (*F. flavioi*) and *Texeirium* (*T. rossicum*) (Tasch, 1958b). Each genus in turn was assigned to a newly erected subfamily of the same name.

The photographic evidence (Nov., 1958, p. 84, fig. 2) for the genus *Teixeirium* will be considered first (Pl. 53, fig. 4a–b). It is based on a right valve which is crushed in both the umbonal region and the lower posterior third. The dorsal hinge line is covered with sediment. An apparent oblique, anteriorly positioned, posterior carina (keel or rib) can be seen.

As one studies the photograph under higher magnification than figured, some curious discrepancies appear. For example, the first four-to-five growth lines are concentric (umbonal area), whereas the growth lines on the portion antero-dorsal to the "apparent" carina are not. (Pl. 53, fig. 4a, arrow.) Instead, the latter forms an acute angle with the umbonal growth lines.

If one tries to follow the median ventral growth lines across the apparent carina to connect them with those seen on the opposite (anterior) side of that structure, again difficulties are encountered. For example, if one counts up to the seventh growth line above the ventral margin (Pl. 53, fig. 4a, arrow) and then proceeds to view the equivalent growth lines on the opposite side of the apparent carina, one notes that two growth lines diverge, one upward, one downward. A count of the number of growth lines, including the ventrally deflected one, indicates that only four are present to the antero-ventral margin. However, such a discrepancy is impossible (seven on one side, four on the other) if the apparent carina and the entire segment anterior to it are in fact part of the same valve!

The reconstruction interprets and obscures all crushed and eroded areas and no such discrepancy is shown. However, study of the photograph (Nov., *op. cit.*, fig. 2, p. 84) suggests that the carina is "apparent" and that the whole segment of which it is the posterior edge, is a broken fragment cemented over another complete valve. Another example of a similar occurrence among fossil conchostracans was recently figured (Tasch, 1958a).

The writer is quite willing to concede that study of the type specimen itself might show the above analysis to be in error. However, the burden of proof of the validity of a taxonomic assignment is on the taxonomist. The published evidence is not convincing, as discussed above.

Even if this genus can be shown indisputably to have the morphology indicated in the interpretive reconstruction, it would not belong to the leaiids since the carina does not cross the umbo. In that event, the preferred assignment would be to the new subfamily Karagandiinae under the family Estheriellidae.

Teixeirium and the subfamily based on it are apparently based on dubious material and cannot be considered documented new names without better evidence.

The second new genus, *Fernandoalmeidium* (Nov., 1958, p. 84, fig. 1, and this paper, Pl. 53, fig. 3a–b) does not merit much extended discussion. The reason is simple. The photograph of the type shows one-half of the left valve obscured so that it is impossible to decipher the original shape. The reconstruction ignores covered and obscure areas on the fossil and shows a postero-dorsal flare among other features that cannot be seen or inferred from the photograph of the type. The fossil might very well not even belong to the conchostracans if the actual (Pl. 53, fig. 3a, this paper) and not the inferred configuration is studied.

Accordingly, this new genus and the subfamily named for it, being inadequately documented and even questionably conchostracan, require more convincing material to be established as new names.

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(*Explanation of Plate 53 will be found on page 384*)

EXPLANATION OF PLATE 53

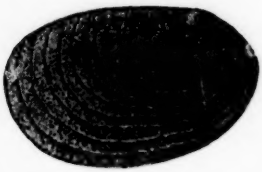
FIG. *1*—*Monoleiopholus karagandica* (Miroshnichenko) reassigned from *Monoleaia karagandica* Miro. *a*, right valve, note crushed median sector and pseudo-carina on posterior margin of this crushed sector. *b*, right valve, reconstruction of fossil shown in *1a*, note absence of indication of crushed sector, of apparent fracture that parallels dorsal margin and presence of restored umbo; compare overall configuration and position of single anterior radial with that seen on fossil and observe how reconstruction and fossil photograph do not correspond in these several details, both ×9.

2—*Paraleaia kasachstanica* (Miro.) reassigned from *Troisleaia kasachstanica* Miro. *a*, the median radial logically extends the definition of the paraleaiids which are characterized by a "median groove or fold." *b*, reconstruction based on *2a*. Compare overall configuration of valve, greater extent of median rib and absence of straight dorsal margin with photograph of *2a*, both ×12.

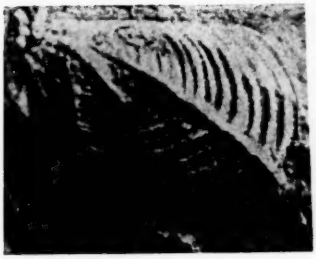
3—*Fernandoalmeidium flavioi* Novojilov, a rejected name based on fossil shown in *3a*. *a*, left valve, note sediment covering apparent dorsal margin, and state of erosion of one-half of the valve as well as sediment cover of the ventral and postero-ventral margin. The shape of this valve and details cannot be deciphered from the photograph. *b*, idealized reconstruction, note restored "dorsal margin," completely defined configuration that cannot be seen in photograph and other minute details not to be found in the photograph. The reconstruction does not indicate obscure and interpreted areas, ×5.

4—*Teixeirium rossicum* Novojilov, a rejected name based on fossil shown in *4a* and reconstructed in *4b*. *a*, note the arrow and the number 7 which indicate that to the right of the apparent rib, two growth lines can be seen to diverge and below the most ventral of these two diverging lines three growth lines can be counted, while on the left side of the apparent rib, seven can counted. This casts doubt on whether these two portions of the valve are, in fact, parts of the same valve; also note that valve has been crushed in the umbonal region. This is a right valve, ×23. *b*, idealized reconstruction of *4a*, compare the concentric growth lines visible on the lower portion of the umbonal area with those shown in *4b;* also note straight hinge-line not visible in the photograph and the absence of evidence of crushing on the reconstruction. Note also that no divergence of growth lines indicated by arrow on photograph is shown in *4b*, ×10.

3A

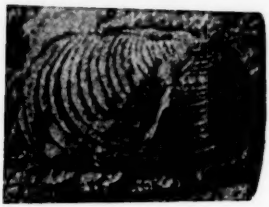


1B



2A

4A



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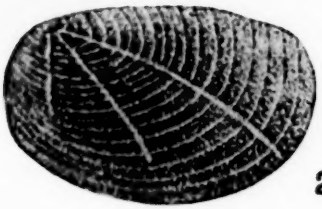

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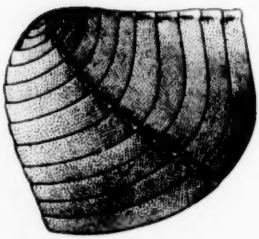
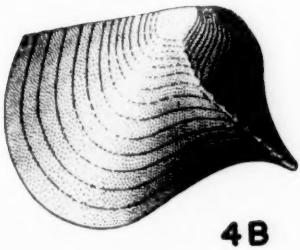


3B



4B

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3

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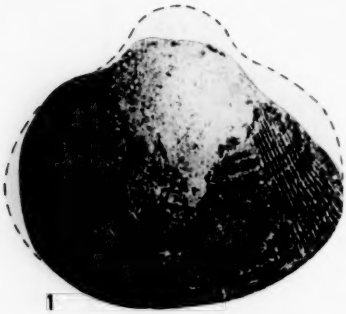
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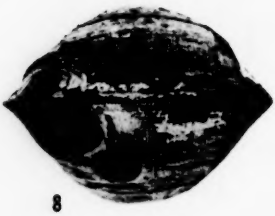
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JOURNAL OF PALEONTOLOGY, V. 35, NO. 2, P. 385–390, PL. 54, 1 TEXT-FIG., MARCH, 1961

NEMOCARDIUM NICOLLETTI FROM THE PALEOCENE MATTHEWS LANDING MARL IN MISSISSIPPI

R. J. HUGHES, JR.
University of Mississippi, University, Mississippi

ABSTRACT—Pelecypods, variously called as time went on, *Cardium*, then *Protocardia*, and then *Nemocardium*, have been described and figured from localities in the Gulf Coastal Plain since 1854. In the present article, for the first time, a specimen of *Nemocardium nicolletti* (Conrad) from Mississippi, found in the Matthews Landing marl member of the Porters Creek clay of Paleocene age, is identified and described. This *N. nicolletti* is compared with specimens from the Matthews Landing marl, Marengo County, Alabama, and at Naheola Landing, on the Tombigbee River, Choctaw County, Alabama. *N. nicolletti* ranges from supposed Middle Eocene down into the Paleocene. No Tertiary species are now referred to the genus *Protocardia*. All Tertiary species, including *N. nicolletti*, once referred to the genus *Protocardia* are now considered to belong under the genus *Nemocardium* Meek.

INTRODUCTION

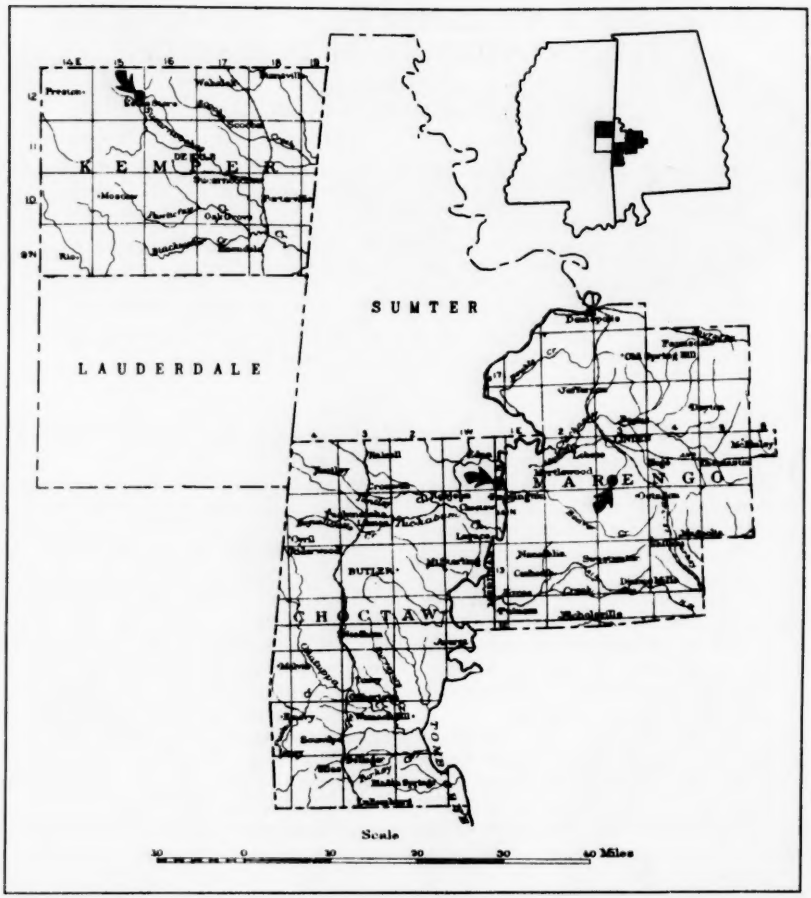
DURING an areal investigation of the lithologic units of Kemper County, Mississippi (Hughes, 1958), the writer was presented with several natural replicas of pelecypods collected by George Sciple from a dug pit at Sciples Mill (SW ¼ Sec. 24, T. 12 N., R. 15 E.), Kemper County, Mississippi (Text-fig. 1). The 20-foot pit was dug in 1952 by prospectors to explore the economic possibilities of phosphate, iron, manganese and "sphalerite," and the fossils were collected from these diggings.

The replicas are from the Matthews Landing Marl member of the Porters Creek Clay of Paleocene age. The Matthews Landing at this locality is 34 feet thick, as evidenced from a drill hole. Elsewhere in the county it is a consistent five to eight feet in thickness and remains as such southeast into Lauderdale County, Mississippi, and into western Alabama. In Choctaw County, Alabama, it is three and one half feet in thickness.

At Sciples Mill, the Matthews Landing Marl is a dusky blue-green (5BG 3/2) glauconite arenite on fresh surfaces, oxidizing to a dusky yellowish brown (10YR 2/2) with intercalated beds of siderite. The glauconite grains range in size from 0.1 mm. to 0.5 mm. (Hughes, 1958). According to Stenzel, Krause & Twining (1957), a glauconite arenite "is a sedimentary rock in which the grains of glauconite are so closely packed that they touch each other, and only the remaining interstices are filled with marl." . . . "Marl is a sedimentary rock of earthy consistency composed of approximately equal parts of clay and calcium carbonate." . . . "Glauconite marl is a sedimentary rock in which grains of glauconite are abundantly distributed in a marl matrix without touching each other; therefore it contains fewer glauconite grains than glauconite arenite

EXPLANATION OF PLATE 54

FIGS. *1–10*—*Nemocardium nicolletti* (Conrad), *1*, from the Matthews Landing marl of Paleocene age, Sciples Mill, Kemper County, Mississippi; external view of left valve, ×1.5, USNM Cen. Cat. No. 563623. *2,3,4*, from the Matthews Landing marl, Marengo County, Alabama; external and posterior views of left valve, internal view of left valve, ×1.8, USNM Cen. Cat. No. 563624. *5–10*, USNM No. 129891. *5,6*, external of left and right valves, ×1. *7,8*, dorsal and ventral views of complete specimen, ×1. *9,10*, anterior and posterior views of complete specimen. ×1. Matthews Landing marl, Naheola Landing, Choctaw County, Alabama.



TEXT-FIG. *1*

and glauconitic marl contains fewer of them than glauconite marl."

The natural replicas from the Sciples Mill area are composed entirely of glauconite, and it is the opinion of the writer that the waters of the shallow epicontinental seas during Paleocene time in this area must have been acidic to account for the disappearance of the shells. The external molds became filled with mud. The iron in the mud was converted to iron sulphide by the decaying organic matter of the dead animal. The iron sulphide was then oxidized to ferric hydroxide with a release of sulphuric acid which acted upon the mud, decomposing it and liberating colloidal silica and alumina. The iron, colloidal silica, and part of the colloidal alumina combined with the potassium salts extracted from the sea water to produce the glauconite.

The pelecypod (Pl. 54, fig. 1) from the dug pit just across the road from the Sciples Store was questionably identified as *Nemocardium* (Hughes, 1958). Subsequently,

more specimens (Pl. 54, figs. 2,3,4) were found at a well known locality of the Matthews Landing Marl in Marengo County, Alabama, and identification was made positive by comparison with these, and with an authentic specimen, collected at Naheola Landing, Choctaw County, Alabama (USNM 129891), and loaned to the writer by the U.S. National Museum (Pl. 54, figs. 5–10). These investigations confirm that the specimen from the Matthews Landing Marl at Sciples Mill, Kemper County, Mississippi, is *Nemocardium nicolletti* (Conrad).

ACKNOWLEDGMENTS

The writer wishes to thank George Sciple for the specimens from the dug pit at Sciples Mill, Druid Wilson of the U.S. National Museum for comments on the *Nemocardium*, G. Arthur Cooper and the U.S. National Museum for furnishing the Naheola Landing specimen, and especially A. Myra Keen, who critically reviewed the systematic description, and made numerous suggestions.

DESCRIPTION OF LOCALITIES

The *Nemocardium nicolletti* localities are in Kemper County, Mississippi, Marengo and Choctaw Counties, Alabama, and are plotted on the locality map (Text-fig. 1) as accurately as possible commensurate with a map of this scale. The three localities are covered by aerial photographs furnished by the Soil Conservation Service.

ML Loc. 1.—Matthews Landing Marl (SW ¼ sec. 24, T. 12 N., R. 15 E.), Kemper County, Mississippi.

ML Loc. 2.—Matthews Landing Marl (SE ¼ NE ¼ sec. 32, T. 15 N., R. 3 E.), Marengo County, Alabama.

ML Loc. 3.—Matthews Landing Marl, Naheola Landing, Tombigbee River (SE ¼ sec. 30, T. 15 N., R. 1 E.), Choctaw County, Alabama.

HISTORY

As early as 1854 Wailes (Pl. XIV, fig. 6) pictured a "*Cardium nicolleti*" from Mississippi, with no reference as to the location or geologic horizon from which it was collected. In 1860 Hilgard referred to "*Cardium Nicolleti?*" in Tippah County, Mississippi, in the siliceous sandstone which he considered to be of Claiborne age because it resembled the Claiborne farther south. The sandstone is now regarded as the Tippah Sand lentil at the base of the Porters Creek Clay. On page 112 his described section of the "Lignitic," at D. Reeve's, northern Tippah County shows he collected "*Cardium Nicolleti?*" with several other fossils from a "clay-sandstone, spotted blue and yellow, with greensand dots." This is the glauconitic marls and sands of the Clayton Formation of Paleocene age of modern workers.

Harris (1896) in his "Midway Stage," one of the classics of Gulf Coastal Plain geology, mentioned *Protocardia* in the "typical Crainesville (Clayton) gray calcareous clay with green grains at Blue Mountain, and in the same horizon 2½ miles northwest of Walnut, Tippah County, Mississippi."

In Alabama Harris collected *Protocardia nicolletti* var. (a variety of Conrad's *Cardium nicolletti*) "large and perfectly preserved" at Naheola Landing on the Tombigbee River from "ferruginous greensand (often indurated) marl . . ." He stated "Immediately at the landing no well preserved fossils were found, but the outcrops perhaps 100 yards below furnished *Protocardia nicolletti* var." These outcrops are the Matthews Landing Marl of modern workers.

The writer knows of no other references, except Harris (1896), to the pelecypods called *Cardium*, then *Protocardia*, then *Nemocardium* in beds at the same stratigraphic position as the Matthews Landing marl at the Sciples Mill locality in Kemper County, Mississippi, and adjacent areas. The present description, which follows, of a specimen of *Nemocardium nicolletti* is the first from beds of that age in Mississippi.

The nomenclatural history of *Nemocardium* is an interesting one. The reader is referred to the works of Keen (1937, 1950, and 1954) and other references dealing specifically with the Family Cardiidae for a more detailed historical treatment. The following brief summary is taken essentially from Keen (1937) and from Neave's "Nomenclator Zoologicus":

Genus CARDIUM Linné, 1758

Reference.—Systema Naturae, ed. 10, p. 678.

Genotype.—*Cardium costatum* Linné, 1758.
Designation.—Children, 1823, Quart. Jour. Sci. p. 315.

Genus PROTOCARDIA Beyrich, 1845

"This name has been unjustifiably emended. to *Protocardium* by Stoliczka on the ground that generic and subgeneric endings should be uniform; it was misspelled *Protocardum* by Meek and Hayden (Proc. Acad. Nat. Sci. Philadelphia, vol. 12, 1860, p. 418)" (Keen, 1937).

Reference.—Zeitschr. f. Malakozool, p. 17.
Genotype.—*Cardium hillanum* J. de C. Sowerby, 1813.
Designation.—Herrmannsen, 1847, Indicis, Gen. Malac., v. 2, p. 336.

Genus NEMOCARDIUM Meek, 1876

Reference.—U.S. Geol. Surv. Terr. (Hayden) Rept., v. 9, p. 167.
Genotype.—*Cardium semiasperum* Deshayes, 1858.
Designation.—Sacco, 1899, I. Moll. Liguria, pt. 27, p. 56.

According to Keen (1950), no American Tertiary species is referred to *Protocardia*. The species, including *N. nicolletti*, once referred there are all now considered to belong under the genus *Nemocardium* Meek.

SYSTEMATIC DESCRIPTION

Phylum MOLLUSCA
Class PELECYPODA
Order EULAMELLIBRANCHIA
Family CARDIIDAE
Subfamily PROTOCARDIINAE
Genus NEMOCARDIUM Meek, 1876

Type species.—*Cardium semiasperum* Deshayes, 1858, p. 573. Eocene of France.
Subsequent designation.—Sacco, 1899, I. Moll. Liguria, pt. 27, p. 56.

Description of type species.—"Shell rounded quadrate, of medium size. Hinge of the left valve with a strong anterior cardinal tooth which is curved upward, and a small posterior cardinal, lateral teeth well removed, of moderate size; hinge of the right valve with a small anterior cardinal and very large posterior cardinal, lateral teeth of moderate size. Posterior slope with radial ribs that are relatively coarse and that may be sculptured with granules or spines; central and anterior slopes often apparently smooth but with fine subsurface ribs reflected as crenulations of the margin. Sculpture and crenulations changing sharply in emphasis and size at the umbonal ridges" (Keen, 1950).

Original generic description.—Meek (1876, p. 167) stated:

"7. *Nemocardium*, Meek

"Shell closely resembling the typical forms of *Protocardia*, but thinner, with two-thirds to three-fourths of surface in front of the stronger posterior, usually echinate, radiating costae, occupied by fine, crowded, radiating striae, and the free margins crenate within all around; cardinal and lateral teeth generally rather slender; pallial line faintly sinuous, irregularly serrated, or nearly simple behind. . . . *Cardium semi-asperum* Deshayes.

"The foregoing is essentially the arrangement of H. and A. Adams, though I have added the group *Criocardium* of Conrad, and *Nemocardium*, and left out *Serripes*. The first of these is an extinct section, presenting the singular character of having spines or nodes arranged in the furrows between the costae, instead of along the crests of the same; while the Eocene section *Nemocardium* forms a curious transition from *Cardium* to the *Protocardia* group.

"The *Nemocardium* section stands, as it were, so exactly intermediate in its characters between the *Cardium* and *Protocardia* groups, that it might, with almost equal propriety, be arranged as a section of either. Deshayes even places the nine Paris-basin species of this type under *Protocardia*, which he views as a section of *Cardium* proper. It differs from *Protocardia*, however, in having fine, radiating costae, instead of concentric markings on the anterior two-thirds of the valves, and the free margins crenate within all around, instead of only posteriorly, also in being thinner, and having a weaker hinge than is usual in the typical species of that group, as well as in the irregularly-serrated appearance of the pallial line posteriorly in some of the species."

Range of genus.—Lower (Neocomian?) Cretaceous to Present.

Subgenus NEMOCARDIUM, *sensu stricto*

Subgeneric description.—"Quadrate, ribbing of posterior slope much coarser than on the remainder of shell, marginal crenulations changing abruptly in size at the boundary between posterior and central slopes; ribs of posterior slope usually with spines, remainder of shell nearly smooth; hinge long and arched, hinge teeth relatively large" (Keen, 1954).

Range of subgenus.—Upper (Aptian) Lower Cretaceous to Present.

Eocene and Paleocene species of *Nemocardium*, s.s. If the author's name is in parentheses, the original allocation is to *Cardium:*

Nemocardium actia (Gardner), 1933 [*Protocardia*], Lower Eocene of Texas.
N. curtum (Conrad), 1869 [*Protocardia*], Eocene of New Jersey.
N. gambrina (Gabb), 1862 [*Protocardia*], Paleocene of Texas.
N. lene (Conrad), 1855, Lower Eocene of Virginia.
N. lima (Conrad), 1865 [*Protocardia*], Middle Eocene of Mississippi.
N. linteum (Conrad), 1855, Eocene down into Paleocene of California.
N. marysvillense (Dickerson), 1916, Lower Eocene of California.
N. nicolletti (Conrad), 1841, Middle Eocene of Louisiana.
N. quihi (Gardner), 1933 [*Protocardia*], Lower Eocene of Texas.
N. salrivalis (Harris), 1919 [*Protocardia*], Middle Eocene of Louisiana.

NEMOCARDIUM NICOLLETTI (Conrad), 1841
Pl. 54, figs. 1–10

Original description.—The following is the original description of *Cardium nicolletti* Conrad: "Cordate, ventricose, polished, with crowded minute, impressed radiating lines; beaks central; summits very prominent; posterior margin nearly direct, slightly emarginate; posterior slope with larger striae than the disk, and muricated with radiating rows of approximate, rather obtuse, slender and prominent tubercles. Length, 2½ inches. Height the same."

Description.—Shell rounded quadrate, dorsal margin straight to gently curved, umbos prominent, turned slightly forward; strong anterior cardinal tooth, small posterior cardinal, lateral teeth on left valve. Surface sculptured by concentric striations faintly developed, numerous equally spaced fine radial subsurface ribs visible at the surface; posterior slope with much coarser ribs having small, flat nodes; ventral margin minutely crenulate, crenulations changing abruptly in size at the boundary between posterior and central slopes.

Dimensions.—The table below lists the range of dimensions in mm. of the figured specimens of Plate 54.

Type locality.—According to Conrad (1841) "For this splendid *Cardium*, I am indebted to my distinguished friend, J. N. Nicollet. It was found in green clay at 50 feet in height on the right bank of the Washita river, Monroe county, Louisiana." The writer was unable to define the locality mentioned by Conrad more specifically by searching the literature. "Washita river," is misspelled and should read Ouachita; "Monroe county, Louisiana" does not exist, the City of Monroe being in Ouachita Parish. It is assumed that the locality is somewhere in Ouachita Parish on the Ouachita River.

Geologic horizon.—*Nemocardium nicolletti* (Conrad) ranges from Early Paleocene to Middle Eocene (Claibornian). In this respect it is similar to the Californian *N. linteum.*

Repositories of material.—The specimen of *Nemocardium nicolletti* (Conrad) from Sciples Mill, Kemper County, Mississippi (Pl. 54, fig. 1) is housed in the collection of the U. S. National Museum (USNM Cen. Cat. 563623). Also, the figured *N. nicolletti* (Conrad) (Pl. 54, figs. 2,3,4) from the Marengo County, Alabama locality is in this collection (USNM Cen. Cat. 563624), as well as the *N. nicolletti* (Conrad) (Pl. 54, figs. 9,10) from Naheola Landing, Choctaw County, Alabama (USNM 129891). The fossils from the Sciples Mill area, Kemper County, Mississippi, and from Marengo County, Alabama were donated by the writer to the U. S. National Museum. The *N. nicolletti* from Naheola Landing, Choctaw County, Alabama was collected by L. C. Johnson.

Remarks.—By referring to the "Geologic

TABLE 1—DIMENSIONS OF FIGURED SPECIMENS SHOWN ON PLATE 54 (in millimeters)

	Height	Length	Convexity	Posterior ribs
Fig. 1	35	35	15 (left valve)	17
Fig. 2, 3, 4	28	31	10 (left valve)	25
Fig. 5–10	42.5	42	14 (left valve)	29

Map of Ouachita Parish" (Wang, 1952), it seems possible that the species of Conrad was collected from the fossiliferous glauconitic clays at the top of the Cook Mountain Formation of Eocene age at old Myatt Landing on the west (right) bank of the Ouachita River in the SE ¼ sec. 34, T. 17 N., R. 3 E. The exact level from which the holotype was collected is unknown.

Besides the type locality, the species has been collected from a fossiliferous, glauconitic sandy marl of the Matthews Landing Marl on a side road about 50 yards west of U. S. Highway 43, SE ¼ NE ¼ sec. 32, T. 15 N., R. 3 E., about four miles south of the town of Linden, Marengo County, Alabama. The bed at this locality is about three and one half feet thick.

Nemocardium nicolletti (Conrad) has been collected at Naheola Landing, a settlement on the Tombigbee River in Choctaw County Alabama. This, the type locality of the Naheola Formation of Midway age, is a bluff on the river in the SE ¼ sec. 30, T. 15 N., R. 1 E.

The type locality of the Matthews Landing Marl, on the Alabama River (N ½ sec. 12, T. 12 N., R. 6 E.), Wilcox County, Alabama, also yields the species.

CONCLUSION

Nemocardium nicolletti (Conrad) has a longer time span than has been cited for it, although the *Protocardia nicolletti* var. collected by Harris (1896) was probably the species later named *Nemocardium nicolletti* (Conrad) and was from Paleocene sediments now known as the Matthews Landing Marl of the Porters Creek Clay. In the present report *N. nicolletti* (Conrad) is shown to range back from its supposed Middle Eocene occurrence into the Paleocene in Alabama and Mississippi. It has not heretofore been reported from the Matthews Landing Marl in Mississippi.

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JOURNAL OF PALEONTOLOGY, V. 35, NO. 2, P. 391–400, 7 TEXT-FIGS., MARCH, 1961

PALEONTOLOGICAL NOTES

OCCURRENCE OF *FOERSTEPHYLLUM* IN CHAZYAN ROCKS OF VERMONT

CHARLES W. WELBY
Trinity College, Hartford, Connecticut

INTRODUCTION

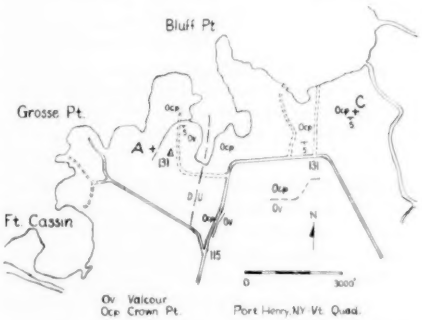
The purpose of this paper is to call attention to the existence of a previously undescribed tabulate coral in the Crown Point and Valcour formations of the Ordovician Chazy group in Vermont (Twenhofel and others, 1954). The form occurs with typical Chazyan Stage fossils in massive, thick-bedded, sublithographic limestones, some of which resemble in general appearance the limestone beds of the overlying Black River Orwell limestone (="Lowville"-Isle la Motte limestones of some authors). Occurrence of cerioid tabulate coral colonies called variously "*Columnaria*" *Favistella*, and *Foerstephyllum*, in medium- to thick-bedded, sublithographic and lithographic limestones has led to placement of the limestones in the Black River Stage or the lowest part of the Trentonian Stage (Kay, 1937; Young, 1943; Erwin, 1957; Kay, 1958).

Discovery of *Nyctopora* in the Middlebury formation of the Middlebury synclinorium (Bassler, 1950, p. 262) and discovery of the form described below indicate that tabulate corals with short septa range below the Black River Stage. Failure to recognize this possibility can result in the miscorrelation of beds of Chazyan age with beds of Black River age. On casual examination the cerioid tabulate coral described below resembles *Foerstephyllum halli* (Nicholson), and its identification as such could lead to such erroneous correlations. Earlier (Welby, in press) this form was termed *Nyctopora?* cf. *N. van tulyi* Bassler, but subsequent study has indicated that the form is more closely allied with *Foerstephyllum*.

This study is published with permission of the Vermont Geological Survey, Dr. Charles G. Doll, State Geologist.

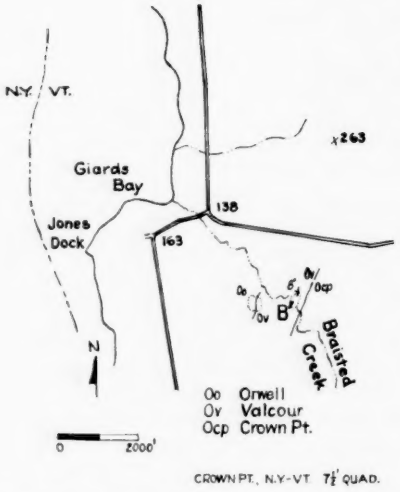
LOCALITIES

The writer has collected specimens of the coral from two localities in the Central Champlain Valley and has seen it at a third locality. The localities from which specimens have been collected are shown in Text-figures 1 (locality A) and 2 (locality B); the third locality is shown in Text-figure 1 (C). At the type locality (Text-fig. 1, locality A) the coral occurs in a massive, thick-bedded, bluish-black limestone; the coralla are exposed on dip slopes along with *Stromatocerium* sp., *Streptelasma* cf. *S. expansum* Hall, and *Lambeophyllum* cf. *L. profundum* (Hall). *Rostricellula pristina* (Raymond) and *Orthambonites ? exfoliatus* (Raymond) have been found in the same bed. Gastropod and brachiopod fragments and *Solenopora* sp. are other faunal elements in the limestone.



TEXT-FIG. 1—Outline map of a portion of the Port Henry, New York-Vermont quadrangle showing type locality (A) of *Foerstephyllum wissleri*. Only the geology pertinent to the stratigraphic position of the type locality is shown.

At the locality in Braisted Creek (Crown Point, New York-Vermont 7½ minute quadrangle; Text-fig. 2) the coral occurs in a dark bluish-gray limestone. A corallum 18 inches or more in diameter can be seen on the bedding surface. An abundance of other forms, including *Batostoma* sp., *Rostricellula*



TEXT-FIG. 2—Outline map of a portion of the Crown Point, New York-Vermont 7½ minute quadrangle showing the Braisted Creek locality (B) of *Foerstephyllum wissleri*.

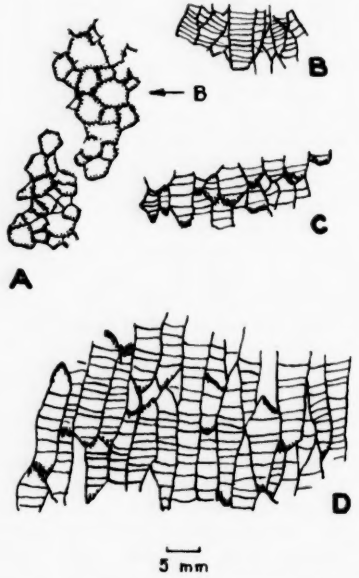
pristina (Raymond), *Dactylagonia incrassata* (Hall), *Orthambonites? exfoliatus* (Raymond) *Loxoplocus* cf. *L. rectistriatus* (Raymond), *Sublites* sp., *Isotelus* sp. fragments, *Ceraurus* sp., pelmatozoan columnals, ostracodes, and *Solenopora* sp. are associated with the coral in a bed approximately 1 foot thick.

Approximately 4500 feet S. 60° E. of Bluff Point in the Port Henry, New York-Vermont quadrangle (Text-fig. 1, locality B) a corallum approximately 6 inches in diameter occurs within typical medium- to thick-bedded, medium bluish gray Crown Point limestone beds which exhibit typical black, platy, silty laminae. Beds stratigraphically above and below the bed containing the corallum have *Maclurites magna* Lesueur outlines and operculi and other faunal elements indicative of a mid-Chazyan age.

Areal mapping shows the coral is in the Crown Point limestone at localities A and C; it is believed that the biostromal-like accumulation on Braisted Creek is within the Valcour formation, although possibly the outcrop may be in the upper portion of the Crown Point limestone. To the west and stratigraphically higher are beds of the Valcour formation which grade upward into the overlying Orwell (Text-fig. 2).

Genus FOERSTEPHYLLUM Bassler, 1950
FOERSTEPHYLLUM WISSLERI Welby, n. sp.
Text-figs. 3,4

Corallum is flat, being only 1 to 2 inches high and averaging 6 inches in diameter but attaining a diameter of as much as 18 inches. Corallum is composed of thin-walled, generally hexagonal corallites which are in contact throughout their length (Text-fig. 3). Fracture takes place across the walls of the corallites rather than through them. Walls are amalgamated with a light to dark division line between them;

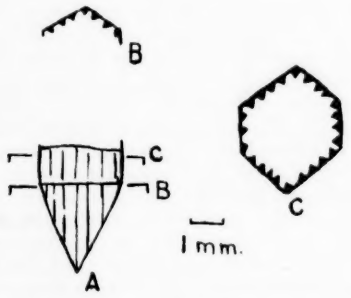


TEXT-FIG. 3—*Foerstephyllum wissleri*. Diagrams are tracings of acetate peels made from slightly etched surfaces.
A. Top view of corallites from type specimen.
B. Vertical section of corallites made normal to the surface of A at position indicated by arrow.
C. Vertical section through another part of the corallum of the type specimen.
D. Vertical section through the corallum at the Braisted Creek locality.

there are no recognizable mural pores. Individual corallites average from 2 to 3 mm. in diameter; a few are between 4 and 5 mm. The corallites increase intermurally, and there is no well marked division into an immature and mature region. Average corallite length is between 10 and 20 mm.

The tabulae are complete, horizontal, rarely arched slightly upward, and they meet the side of the corallite perpendicularly. Tabulae range in number from 3 to 5 per 5 mm. of corallite length.

Twenty-four denticulated septa, triangular in cross-section, extend into the corallite between one-tenth and one-quarter of the corallite diameter, emerging from straight walls (Text-fig. 3,4C). The septa appear to extend to the center of the corallite on the tabulae. Two septa are secreted initially, arising at the point of budding and extending up the corallite in interior angles diametrically opposite one another. A second pair of septa appear at the same time or shortly thereafter at right angles to the plane of the first pair of septa. Then three series of septa in pairs on either side of the primary septa appear as the corallite expands. The final series appears just below the first tabula or at the time of its secretion. Text-figure 4 shows diagrammatically sections through a corallite which illustrate the addition of the septa. Septa of the several series cannot be distinguished above the first tabula, all being alike in appearance; the position of each in the corallite beneath the initial tabula is the only distinguishing feature.



TEXT-FIG. 4—Single corallite, showing diagrammatically the addition of the septa.
A. Vertical section.
B. Top view of vertically sectioned corallite at a level immediately below the first tabula.
C. Top view of complete corallite between the first and second tabulae.

When viewed from the top of the corallum, the arrangement of the corallites and of the septa within the corallites closely resemble *Foerstephyllum* (Bassler, 1950). The number of septa, furthermore, corresponds with that given for *Foerstephyllum*. In describing the genus Bassler (1950, p. 269) notes, however, the presence of well defined mature and immature regions; furthermore, he notes that the septa do not appear in the immature region. As described above, the septa of *Foerstephyllum wissleri* begin with the inception of the new corallite. Comparison of *F. wissleri* with a specimen collected from the Orwell biostrome on Button Island (Port Henry quadrangle) (Seely, 1910, p. 275) and identified as *Foerstephyllum halli* (Nicholson) shows that the two corals resemble one another closely. The specimen from Button Island has larger corallites, averaging 20 to 30 mm. in length and 3 to 4 mm. in diameter. The denticulated septa of *Foerstephyllum halli* from Button Island appear at the point of budding and extend the length of the corallite; no well defined mature and immature regions are present. Aside from these differences from the description of *Foerstephyllum halli* (Nicholson) given by Bassler (1950), the form fits the description of *Foerstephyllum halli* (Nicholson); Seely (1910, p. 275) called the form *Columnaria alveolata*, one of the many synonyms for the form now called *Foerstephyllum*. Thus it is felt that the form to which the name *Foerstephyllum wissleri* is given belongs to the genus *Foerstephyllum*. *Foerstephyllum wissleri* resembles closely *Foerstephyllum parvulum* Bassler, but the spacing of the tabulae does not agree with that given for this form.

The holotype and paratype from locality A, approximately 700 feet N. 88° W. of triangulation point 131, east of Grosse Pointe in the Port Henry, New York-Vermont 15 minute quadrangle (Text-fig. 1), are in the Harvard University Museum of Comparative Zoology collections, Nos. 9359 and 9360, respectively. The trivial name is given for Professor Benjamin F. Wissler of Middlebury College who aided in the collection of the type specimens.

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AGE OF THE CASTLE HAYNE FAUNA (EOCENE) OF NORTH CAROLINA

ALAN CHEETHAM
Louisiana State University, Baton Rouge

INTRODUCTION

One of the paradoxes of stratigraphy is that some of the most fossiliferous rocks are the most difficult to correlate paleontologically. In the southeastern United States, for example, Eocene deposits, first recognized more than 100 years ago by Sir Charles Lyell, contain a multiplicity of fossils unexcelled anywhere in the world, yet biostratigraphic partition of these rocks and intraprovincial correlation of the stages and zones so derived are as subject to controversy now as they were during the last century.

Standard paleontological divisions of eastern American Eocene rocks were derived mainly in the Gulf Coast where faunal composition has been influenced strongly by the tropical maritime climate. Some Gulf Coast units, *e.g.*, the Ocala of Florida, incorporate a particularly impressive array of Old World tropical (Tethyan) forms (Richards & Palmer, 1953). Few tropical invertebrates lived as far north as the Carolinas in Eocene time, however. Then, as now, the North American Atlantic temperate province was characterized by some tropical and boreal forms and many endemic temperate forms.

These considerations leave little basis for surprise that some Atlantic Coast formations, such as the Castle Hayne marl of North Carolina, have been shifted by various biostratigraphers from one Gulf Coast stage to another, in this case the Jackson (upper Eocene) and the Claiborne (middle Eocene).

CHARACTER OF FAUNA

Although Sir Charles Lyell in 1845 first recognized as Eocene the marls and limestones in the vicinity of Wilmington, North Carolina, it was 65 years later that Miller (1910) named them for the town of Castle Hayne on the Cape Fear River. T. W. Vaughan (*in* Miller, 1910) regarded the Castle Hayne fossils as peculiar but recognizably Jacksonian. Eocene fossils from the Wilmington area were described sporadically by many eminent paleontologists, but the first extensive faunal work was Canu & Bassler's (1920) monograph in which are listed 155 species of cheilostome bryozoans from the Wilmington exposure alone. Kellum's (1926) monograph deals with the larger invertebrates, comprising 39 species excluding those left *nomina aperta*. Canu & Bassler and Kellum agreed in assigning the Castle Hayne fauna to the Jacksonian, but Cooke & MacNeil (1952), in their paper on the Tertiary stratigraphy of South Carolina, concluded that the Castle Hayne belongs in the Claiborne Stage. In a later paper Cooke (1959) showed the formation as "late and middle Eocene" in a correlation chart but wrote of it as "late middle Eocene" in the text. LeGrand & Brown (1955), after extensive field studies of the Castle Hayne, be-

came convinced that "the deposition of the formation commenced during the middle Eocene and continued in a transgressive sea throughout the late Eocene."

As pointed out by Cooke and others, much of the controversy about the age of the Castle Hayne fauna stems from the fact that 24 of the 39 species of larger invertebrates (61%) are endemic to the Castle Hayne or to the Castle Hayne and Santee (the underlying formation in South Carolina). *Chlamys membranosus* (Morton), *Periarchus rutriformis* Paulson, and *Unifascia carolinensis* (Clark), among the most characteristic Castle Hayne species, are unknown outside the Carolinas. Forms known from the Gulf Coast are about evenly divided among Jacksonian (6 species), Claibornian (6 species), and Claibornian-Jacksonian (3 species). *Aturia alabamensis* (Morton), *Ostrea trigonalis* Conrad, and *Terebratulina lachryma* (Morton) typify the indicators of Jacksonian age, whereas *Chlamys deshayesii* (Lea), *Crassatella alta* Conrad, and *Ostrea sellaeformis* Conrad suggest Claibornian age.

A fact that has been overlooked in many discussions of the age of the Castle Hayne fauna is that the bulk of the species, fully 80 percent, are cheilostome bryozoans. About 55 percent of the species are endemic to the Carolinas, *i.e.*, are restricted to the Castle Hayne or to the Castle Hayne and Santee, but 44 percent occur also in unequivocally Jacksonian deposits in South Carolina, Georgia, or the Gulf Coast (Table 1). In contrast, just over one percent are known from beds definitely assigned to the Claiborne Stage. Moreover, among the cheilostome species of Gulf Coast Jacksonian affiliation, 74 percent indicate an age no older than middle Jacksonian and 48 percent indicate an age no older than late Jacksonian. Some of the larger invertebrates reported by Kellum, notably *Ostrea falco* Dall and *Terebratulina lachryma*, also suggest upper Jacksonian, or even higher, affiliation.

CONCLUSIONS

If the age of the Castle Hayne is late Jacksonian, how can the occurrence of such Claibornian forms as *Chlamys deshayesii*, *Crassatella alta*, and *Ostrea sellaeformis* and Jacksonian bryozoans and other invertebrate fossils in the same beds at the same exposures be explained? At least part of the answer is found in Kellum's remarks regarding the mode of preservation of the Castle Hayne pelecypods. Most of these are internal molds and external casts hardly amenable to precise identification. In the case of *Ostrea sellaeformis*, Kellum states that "the specimens . . . are all small forms and, for the most part, belong to the varieties *divaricata* Lea and *rugifera* Dall." These "varieties" are now considered to be distinct species not even belonging to the *O. sellaeformis* stock (Stenzel, 1949). Moreover, as pointed out by Julia Gardner and reiterated by H. V. Howe (1937), young oysters defy identification.

TABLE 1—ANALYSIS OF CASTLE HAYNE CHEILOSTOME FAUNA

Total number of cheilostome species	155
Number of species restricted to:	
Castle Hayne	59
Castle Hayne and Santee	86
Number of Castle Hayne species that occur in:	
Santee	49
Jacksonian of Georgia and South Carolina (Barnwell, Twiggs & Tivola)	30
Jacksonian of Gulf Coast	58
Jacksonian of Georgia, South Carolina, or Gulf Coast	68
Claibornian of Gulf Coast	2
Number of Castle Hayne species that occur in Gulf Coast in:	
Upper Jacksonian beds and no lower	28
Middle Jacksonian beds and no lower	15
Lower Jacksonian beds and no lower	15

The weight of evidence thus indicates very clearly that the Castle Hayne fauna, as recognized in the classical exposures in North Carolina, lived in late Jacksonian time. Downdip, where the term "Castle Hayne" has been applied to a lithological unit in the subsurface, the contained microfauna indicates Claibornian age (Brown, 1958). This relationship may be explained by updip onlap as suggested by LeGrand & Brown (1955).

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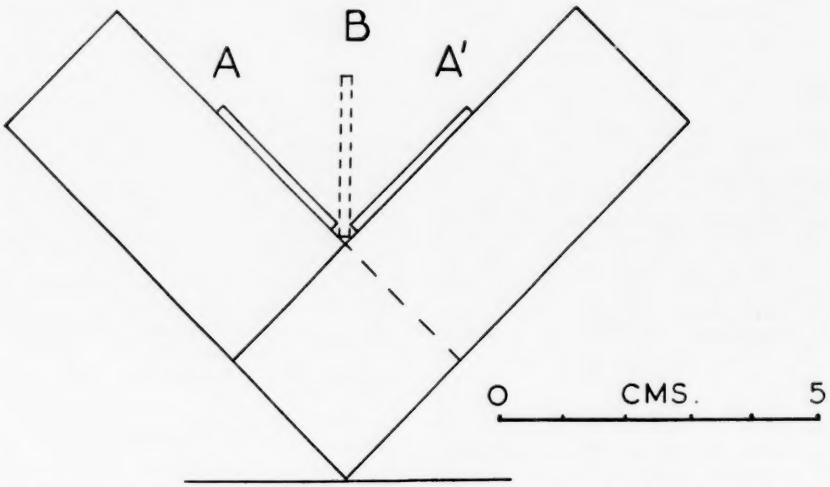
A SIMPLE MICRO-SAMPLE SPLITTER

M. C. KENNARD AND ALEC J. SMITH
Department of Geology, University College London, England

Geologists working with fine grained materials frequently wish to obtain small, statistically representative portions of the whole sample so as to avoid laborious counting. When the total sample may not weigh more than a few grams there is need for some form of mechanical splitter which itself is of a small size. The sample splitter described here was devised for use by micropalaeontologists and mineralogists working in the Department of Geology, University College London. It is simple in design, easy to construct and is made from inexpensive materials. It has proved to be a satisfactory tool and we commend it to other geologists who have to work with materials of small grain size.

The splitter is constructed entirely of



TEXT-FIG. 1—End view of micro-sample splitter showing positions of slides. *A* and *A*¹ face the trough. *B* is used as a spacer and is subsequently removed.

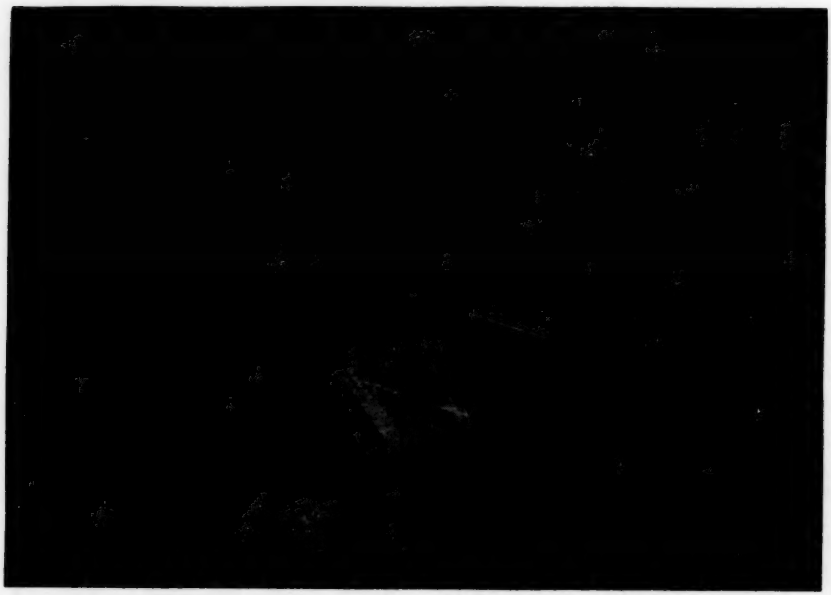
standard petrological microscope slides, 76 mm. long, 25 mm. wide and 1.2 mm. in thickness. To aid the free movement of grains through the splitter one long edge of each slide should be ground with fine grade carborundum and polished with a fine polishing medium. The slides are then fixed together, with an adhesive, at right angles so that they form a trough with successive slides making channels facing in opposite directions. The trough should be equal to the length of a slide (this gives 34 slides on each side of the trough). Two slides should be fixed to the inside face of the trough. As these slides are placed in position they should be held apart by a third slide which is removed when the first two slides are firmly adhered to the trough faces. The position of these slides is shown in Text-figure 1: A and A^1 are the slides which face the trough, B is the slide used as a spacer and subsequently removed. The two slides which face the trough serve a dual purpose. They direct the sample to the centre of the splitter which ensures an even split and at the same time the gap between these slides is such that only grains small enough to pass through the splitter are allowed to fall into the channels of the splitter, thus avoiding any blocking of the channels.

TABLE 1—DIMENSIONS OF SPLITTER

Length:	107 millimetres
Width:	80 millimetres
Height:	80 millimetres

The splitter is completed by the addition of one or two slides at each end of the trough to act as supports for the splitter. A general view of the splitter is shown in Text-figure 2.

It has been found that the splitter is best cleaned by compressed air.



TEXT-FIG. 2—Oblique view of completed micro-sample splitter.

THE OSTRACODES OF SABINE LAKE AND SABINE PASS, TEXAS AND LOUISIANA, AND THE NEARSHORE AREA OF THE GULF OF MEXICO

HENRY E. KANE
Fort Hays Kansas State College, Hays, Kansas

Sabine Lake and Sabine Pass are located in the extreme southeastern corner of Texas and the southwestern corner of Louisiana, covering parts of Orange and Jefferson Counties, Texas, as well as part of Cameron Parish, Louisiana. The nearshore area of the Gulf of Mexico parallels the southern margin of the lake and pass region and extends approximately 4½ miles offshore.

Ostracodes identified in the surficial sediments of Sabine Lake are as follows: *Asterocypris* sp., *Cytherura johnsoni* Mincher, *Cytherura* sp., *Haplocytheridea bradyi* (Stephenson), *Loxoconcha australis* Brady, *Perissocytheridea brachyforma* Swain; in Sabine Pass: *?Cytheromorpha* sp., *Cytherura johnsoni* Mincher, *Haplocytheridea bradyi* (Stephenson), *Hulingsina sulcata* Puri, *Perissocytheridea brachyforma* Swain; in the Gulf of Mexico: *Actinocytheresis exanthemata* (Ulrich & Bassler), *Actinocytheresis subquadrata* Puri, *Cushmanidea* sp., *Cytherura costata* (Müller), *Cytherura* sp., *Limnocythere sanctipatricii* Brady & Robertson, *Loxoconcha australis* Brady, *Loxoconcha matagordensis* Swain, *Paradoxostoma ensiforme* Brady, *Perissocytheridea brachyforma* Swain.

The following ostracodes are found in the sediments 6 feet below the surficial sediments of Sabine Lake: in the northern part of the lake, *Candona marchica* Hartwig, *Cyprideis littoralis* Brady, (?) *Cytheromorpha pascagoulaensis* Mincher, *Cytheromorpha* sp., *Darwinula aurea* (Brady & Robertson), *Perissocytheridea brachyforma* Swain; in the southern part of the lake, *Cushmanidea* n. sp., *Cytheromorpha pascagoulaensis* Mincher, *Cytherura johnsoni* Mincher, *Leptocythere* (?) n. sp., *Loxoconcha australis* Brady, *Perissocytheridea brachyforma* Swain, *Perissocytheridea* sp.

The writer wishes to thank Shell Development Company for its financial grant toward this project and Harbans S. Puri, who identified the ostracodes.

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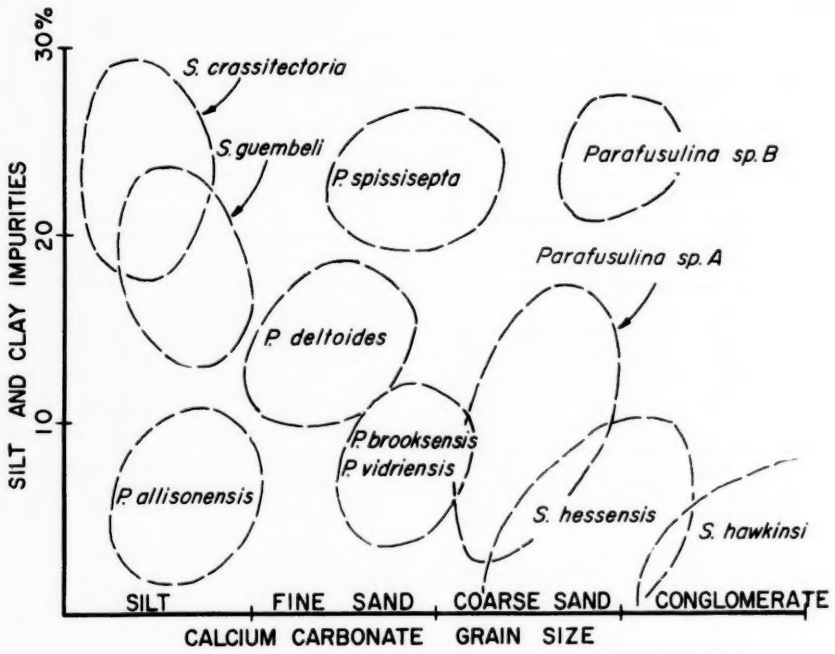
FUSULINIDS AS PALEOECOLOGICAL INDICATORS

CHARLES A. ROSS
Illinois State Geological Survey, Urbana

Since about 1925, fusulinids have been studied extensively for purposes of zoning Pennsylvanian and Permian strata. The value of these fossils in stratigraphic zonation is enhanced by their rapid and divergent evolution into many short-lived lineages which are recognizable both at specific and generic levels. Rapid evolution of this type in groups having recent representatives, such as mammals, insects, and Foraminifera, commonly show a specialization into specific habitats or modes of life.

It is not surprising, therefore, to find in the fusulinids many species that are closely associated with a particular rock type. The species of fusulinids discussed herein are from the Leonard series, Glass Mountains, Texas, and were described by Dunbar & Skinner (1937) and Ross (1960a). Two genera and 11 species are abundantly distributed in the limestone sequence, and Text-figure 1 shows these species as they are distributed according to lithology (Ross, 1960b).



TEXT-FIG. 1—Occurrence of species of *Schwagerina* and *Parafusulina* in different lithologies in the Leonard formation, Glass Mountains, Texas.

The lower part of the Hess member of the Leonard formation in the eastern part of the Glass Mountains consists of clayey and silty calcilutite, fine calcarenite, and, near the top, silty and clayey fine calcarenite interbedded with shale. Calcareous algae (genus *Mizzia*) are common in many beds. The depositional environment was apparently beneath the zone of wave agitation, away from shore so that only fine size clastics reached the area, and sufficiently shallow to be in the photic zone. *Schwagerina crassitectoria* Dunbar & Skinner, *S. guembeli* Dunbar & Skinner, *Parafusulina allisonensis* Ross, and *P. deltoides* Ross at different times apparently thrived in this set of environments. The upper Hess fossil horizon (King, 1931) has cobbles and pebbles at its base, and the fossils in the sandy upper part are commonly coated with thick algal rims having an appearance similar to that of sea biscuits. These strata with *Parafusulina spissisepta* Ross and the overlying calcarenite with oolids having *P. brookensis* Ross and *P. vidrensis* Ross seem to have been deposited in shallow warm water which was agitated regularly by waves.

The lower part of the Leonard formation in the western Glass Mountains has a more complex sequence of intertonguing lithologies, and the vertical distribution of the species of fusulinids is also more complex than in the Hess member of the eastern Glass Mountains. The species commonly reappear in the succession in lenses of similar lithology. Four species found in the Hess member, *Schwagerina crassitectoria, S. guembeli, Parafusulina allisonensis,* and *P. spissisepta,* occur also in thin lenses in the Leonard formation in the western Glass Mountains. Four species, *Schwagerina hessensis* Dunbar & Skinner, *S. hawkinsi* Dunbar & Skinner, *Parafusulina* sp. A, *Parafusulina* sp. B, however, are restricted to

lithologies found only in the Leonard formation in the western Glass Mountains. The calcirudite with *Schwagerina hawkinsi* at the base of the formation has large crinoidal fragments, attached brachiopods, and is lenticular and interbedded with coarse well sorted calcarenite having *S. hessensis*. These strata were apparently deposited in a shallow water, high wave energy environment, possibly where waves were breaking. The silty, medium to coarse calcarenite beds with *Parafusulina* sp. A represent fans of sand-size debris from the high wave energy environment.

In the upper part of the Leonard series *Parafusulina* sp. B occurs in silty calcarenite having abundant brachiopods and crinoidal fragments. These beds intertongue with siltstone, and farther east they intertongue with bioherms that suggest a slightly protected, shallow water environment.

The close association of each of these species with particular rock types indicates that these species were benthonic and sensitive to bottom environments. Thus species of fusulinids can be used in paleoecologic studies as well as in stratigraphic zonation.

Acknowledgment.—This study was in part supported by grants from the American Association of Petroleum Geologists and the American Philosophical Society.

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JOURNAL OF PALEONTOLOGY, V. 35, NO. 2, P. 401–402, MARCH, 1961

NOMENCLATURAL NOTES

NEW NAME FOR A TRIASSIC PELECYPOD

ABRAHAM LERMAN
Department of Geology, Harvard University, Cambridge, Massachusetts

The species *Myophoria multicostata* has been described (Lerman, 1960, p. 20, pl. 2, figs. 1–6) from the Middle Triassic beds of Makhtesh Ramon in the Negev (Southern Israel). Dr. K. Ichikawa of Osaka City University has kindly drawn the author's attention to the fact that the name *M. multicostata* is preoccupied by *M. multicostata* Körner (1937, p. 183, pl. 12, figs. 3a,b). Therefore the new name *Myophoria negevensis* is hereby proposed for *M. multicostata* Lerman (*non* Körner).

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NEW PENNSYLVANIAN BRACHIOPODA FROM SOUTHWEST MISSOURI: CORRECTIONS

R. D. HOARE
Bowling Green State University, Bowling Green, Ohio

In a note published in the July 1960 issue of this Journal, J. Marvin Weller questions the validity of the authorship of the species *Mesolobus striatus* as assumed by Hoare (1960). The basis for this objection appears to be the use of *nomen nudum* applied to Weller & McGehee's (1933) designation of this species. After further interpretation of the Rules of Zoological Nomenclature, it can be construed that the original discussion of *Mesolobus striatus* constitutes valid authorship by Weller & McGehee, even though they failed to follow up their original incomplete description as promised. Also, because the figures by Girty (1915), used as reference by Weller & McGehee (1933), are of specimens which are not catalogued nor located by distinct stratigraphic or geographic criteria, they should not be designated as type material. Therefore, it is proposed that the specimens used as types by Hoare (1960) be designated as the types for *Mesolobus striatus*.

Accurate description and illustration of type specimens in connection with the designation of a new species is of utmost importance in taxonomic procedure. Unfortunately this was not done by the authors in this case. While *Mesolobus striatus* has been recognized and used by paleontologists concerned with Lower Pennsylvanian faunas, as pointed out by Weller, the erection of a new name with inadequate description and without designation of type specimens is a practice which results in ambiguous and erroneous taxonomic conclusions.

That the radial ornamentation of *Mesolobus striatus* is actually lirate and not striate, as described by Weller & McGehee (1933) and Hoare (1960), has been pointed out by Walter Sadlich (personal communication). Girty (1915) described the specimens he illustrated from Flint Ridge, Ohio, as lirate. Subsequent sectioning of the shell material by Hoare substantiates this conclusion.

The species *Desmoinesia muricatina* (Dunbar & Condra) was mistakenly given as *D. muricatina* (Norwood & Pratten) on p. 226 and in the explanation of Plate 33 (Hoare, 1960).

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JOURNAL OF PALEONTOLOGY, V. 35, NO. 2, P. 403–404, MARCH, 1961

REVIEW

FOSSIL MAMMALIA FROM THE EARLY WASATCHIAN FOUR MILE FAUNA, EOCENE OF NORTHWEST COLORADO, by Malcolm C. McKenna. University of California Publications in Geological Sciences, v. 37, no. 1. 130 p., 64 text-figs. June 10, 1960. Paperbound $2.50.

The fauna described dates from near the beginning of early Eocene time, and is from the lower part of the Hiawatha member of the Wasatch formation. Most of the material was obtained by washing of large amounts of sediments from several "quarries." This method of recovery, first extensively used by C. W. Hibbard in rocks of the Late Cenozoic of Kansas, resulted in recovery of numerous but fragmentary specimens. Most specimens are isolated teeth, but jaws bearing from one to several teeth were sometimes found. Compensating for the fragmentary character of the specimens are two circumstances: (1) beds seemingly almost completely barren when prospected by more orthodox collecting means produced fair numbers of specimens, and (2) remains of small mammals (insectivores, rodents) were recovered far more frequently than with standard methods of prospecting for fossils. On the other hand, the fragmentary specimens produce their own set of problems and frustrations.

The Four Mile Fauna now consists of some 20 species of lower vertebrates and 58 species of mammals, but only the mammalian species are described in McKenna's publication. These 58 mammalian species are assigned to 25 families and 12 orders. An adequate sample of the actual Four Mile Fauna obviously has been obtained, and permits accurate geological dating. Named as new by McKenna is one genus, *Niptomomys*, and five species, *Paradectes protinnominatus*, *Leptacodon jepseni*, *Niptomomys doreenae*, *Cynodontomys alfi*, *Hyopsodus loomisi*. He has refrained from naming as new some taxa in which no available specimen seemed adequate as a type. No use is made by McKenna of subspecies in his formal listing of the Four Mile Fauna, but possible temporal and geographic subspecific designations are discussed in several instances. So far as possible, the author has treated his specimens in the "modern" way as samples, more or less adequate, from which inferences may be drawn as to the characteristics of the population.

McKenna's descriptions and comparisons of the mammalian species are detailed and extensive. He has made or suggested a number of systematic changes affecting categories ranging from species to family. Vigorous discussion by specialists of some of these changes will undoubtedly follow. In a sense, because of the delay between writing and publication, this has already happened in one case. The genus *Apheliscus* was placed tentatively by W. D. Matthew in the insectivores as the sole representative of the family Apheliscidae. C. L. Gazin has reviewed recently (1959) the status of *Apheliscus*, and has suggested that it is a pantolestid insectivore, whereas McKenna in the present publication assigns *Apheliscus* to the hyopsodontid condylarths. Whatever the final disposition of some of these changes may be, McKenna is to be congratulated not only for an excellent description of his material, but also for stimulation to paleontologists for additional study and thought provided by his challenges to the present systematic arrangements of Paleocene-Eocene mammals.

The more important systematic changes, at higher taxonomic levels, are: (1) the superfamily Deltatherioidea Simpson is transferred from the Insectivora to the Carnivora; (2) the family Nyctitheriidae Simpson is abandoned; (3) the family Amphilemuridae Heller is recognized in North America for the first time; (4) the families Apatemyidae Matthew and Tupaiidae Mivart are referred to the Menotyphla rather than to the Primates (this is not a new idea, but it is a reversal from the recent consensus); (5) the family Phenacolemuridae Simpson is rejected in favor of the available Paromomyinae Simpson; (6) the Mixodectinae and Microsyopinae are reëlevated to family status for each, the Mixodectidae Cope being assigned to the Menotyphla and the Microsyopidae Osborn to the Primates; and (7) the family Apheliscidae Matthew is

removed from the Insectivora, and made a subfamily of the condylarth family Hyopsodontidae Lydekker.

In addition to a consideration of the mammalian species present in the Four Mile Fauna, sections are devoted to the general geology of the Four Mile area, to methods of recovery of the specimens, to numerical representation of the various species at each of the collecting sites, and to the geochronologic significance of each of the Four Mile species.

The text seems exceptionally free from error. This reviewer noted only one typographical error, and one error of fact (upper molars of *Pentacodon* are known—W. D. Matthew, p. 225, Trans. Amer. Philos. Soc., n.s., 30, 1937; C. L. Gazin, pl. 2, fig. 5, Smithsonian Misc. Coll., 139, no. 7, 1959—contrary to the statement by McKenna on p. 113). Another kind of "error" appears once as a result, I suspect, of attempting to keep up to date a manuscript written over a period of years. McKenna, in discussing the primate genus *Paratetonius*, cites on page 74 Gazin, 1952, but not Gazin, 1958, on the same subject, although earlier, on page 67, he has cited the latter paper. He subsequently comes to conclusions on page 74 that appear to correct or that emend Gazin's statements, although in fact his conclusions mostly were anticipated by Gazin in 1958. In a paper as long as McKenna's, complete freedom from error probably never is achieved.

The illustrations, the work of Owen J. Poe, are excellent, as McKenna himself has noted.

ROBERT W. WILSON
Museum of Natural History
The University of Kansas
Lawrence

JOURNAL OF PALEONTOLOGY, V. 35, NO. 2, P. 405–432, MARCH, 1961

SOCIETY RECORDS AND ACTIVITIES

NEW OFFICERS, S.E.P.M.

For the year ending April, 1962

President: LAWRENCE L. SLOSS, Northwestern University, Evanston, Illinois.
Past-President: WILLIAM M. FURNISH, State University of Iowa, Iowa City, Iowa.
Vice-President: KENNETH E. LOHMAN, U. S. Geological Survey, Washington, D. C.
Secretary-Treasurer: LLOYD C. PRAY, The Ohio Oil Company, Littleton, Colorado.
Councilor (Paleontology): LYMAN D. TOULMIN, Florida State University, Tallahassee, Florida.
Councilor (Sedimentary Petrology): ALBERT L. KIDWELL, Jersey Production Research Company, Tulsa, Oklahoma.
Editors, Journal of Paleontology: M. L. THOMPSON & CHARLES COLLINSON, Illinois State Geological Survey, Urbana, Illinois.
Editor, Journal of Sedimentary Petrology: LEWIS M. CLINE, University of Wisconsin, Madison, Wisconsin.

NEW OFFICERS, PACIFIC COAST SECTION S.E.P.M.

through November, 1961

President: EDWIN H. STINEMEYER, Shell Oil Company, Bakersfield, California.
Secretary-Treasurer: WILLIAM J. LEWIS, Standard Oil Company of California, Oildale, California

ANNUAL MEETING, PERMIAN BASIN SECTION, S.E.P.M.

The annual business meeting and technical session of the Permian Basin Section, S.E.P.M., will be held in the Scharbauer Hotel, Midland, Texas, April 13–15. Registration will begin Thursday afternoon, April 13. Mr. Bernold Hanson is general chairman. The theme of the technical program is *Sedimentation*. Papers for the session should be submitted to Mr. Hanson, 110 N. Big Spring Street, Midland, as early as possible.

GARNER WILDE, President
Permian Basin Section

BEST PAPER AWARD, PACIFIC COAST SECTION, S.E.P.M.

The 1960 Best Paper Award of the Pacific Coast Section, S.E.P.M., was won by Dale Wiggins, Standard Oil Company of California, Western Operations, Inc. The title of his paper was *A Mississippian Microspore Assemblage from White Pine County, Nevada.*

ANNUAL TECHNICAL SESSION, PACIFIC COAST SECTION, S.E.P.M.

The annual technical sessions of the Pacific Coast Section, S.E.P.M., were held in Los Angeles, November 3 and 4. The following papers were presented:

1. FORAMINIFERAL VARIATION IN SEDIMENT LAYERS OF THE SANTA BARBARA BASIN, CALIFORNIA, Robert A. Harman, University of California, Los Angeles.
2. ONTOGENETIC VARIATION IN *EPONIDES REPANDUS* (Fichtel & Moll), Johanna Resig, University of Southern California.
3. FORAMINIFERA FROM THE PLEISTOCENE GUBIK FORMATION OF NORTHERN ALASKA, Helen Tappan, University of California, Los Angeles and U. S. Geological Survey.
4. CALIFORNIA CRETACEOUS "SIPHOGENERINOIDES," M. A. Furrer, California Research Corporation.
5. STRATIGRAPHIC PALEONTOLOGY OF THE JALAMA FORMATION, WESTERN SANTA YNEZ MOUNTAINS, SANTA BARBARA COUNTY, CALIFORNIA, Donald Howard Dailey, Richfield Oil Corporation.

6. FACIES RELATIONSHIPS OF THE SESPE AND ALEGRIA FORMATIONS, SANTA BARBARA COUNTY, CALIFORNIA, Don L. Protzman, East Los Angeles College.
7. STRATIGRAPHIC DISTRIBUTION OF DIATOM FLORAS IN THE SISQUOC FORMATION OF THE PURISIMA HILLS, CALIFORNIA, Walter W. Wornardt, Jr., University of California, Berkeley.
8. SUPRAGENERIC CLASSIFICATION OF THE RHIZOPODEA, Alfred R. Loeblich, Jr., California Research Corporation, Helen Tappan, University of California, Los Angeles.
9. MECHANISMS OF MOVEMENT: THE BASIS FOR A NEW MAJOR DICHOTOMY OF THE SARCODINA, Theodore L. Jahn, Department of Zoology, University of California, Los Angeles, Eugene C. Bovee, Department of Biology, University of Florida, Eugene B. Small, Department of Zoology, University of California, Los Angeles.
10. A MISSISSIPPIAN MICROSPORE ASSEMBLAGE FROM WHITE PINE COUNTY, NEVADA, Dale Wiggins, Standard Oil Company of California.
11. POLLEN MORPHOLOGY OF RAPATEACEAE, Sherwin Carlquist, Claremont Graduate School, Claremont, California.

PROGRAM FOR S.E.P.M. DENVER MEETING

April 24–27

LAWRENCE L. SLOSS, *Technical Program Chairman*
THEODORE R. WALKER, *Cochairman*, assisted by JOHN CHRONIC

RESEARCH COMMITTEE SYMPOSIUM: WATER MOVEMENTS AND SEDIMENTATION

1. SEDIMENTATION IN TIDAL FLAT AREAS OF THE NETHERLANDS, L. M. J. U. von Straaten, Geological Institute, Groningen, Netherlands
2. GENESIS OF BARRIER ISLAND AND CHENIER SAND BODIES AS RELATED TO SEDIMENT INFLUX AND PROCESSES, H. A. Bernard,* C. F. Major and B. S. Parrott, Shell Development Company, Houston, Texas
3. RELATIONS OF REEFS TO WATER CIRCULATION, Joshua I. Tracey, Jr., U. S. Geological Survey, Washington, D. C.
4. THE EFFECT OF WIND-DRIVEN WATER MOVEMENT ON SEDIMENT DISTRIBUTION, GULF OF BATABANO, CUBA, Albert L. Kidwell, Jersey Production Research Company, Tulsa, Oklahoma
5. SALINITY OF FLORIDA BAY, John S. McCallum, Shell Oil Company, Roswell, New Mexico and Kenneth W. Stockman,* Shell Oil Company, Coral Gables, Florida
6. MOLLUSCAN DISTRIBUTION IN FLORIDA BAY, W. J. Turney, Shell Oil Company, Roswell, New Mexico
7. VARIATIONS IN THE O^{18}/O^{16} RATIOS OF FLORIDA BAY MOLLUSKS AND THEIR APPLICATION TO PALEOGEOGRAPHIC STUDIES, R. Michael Lloyd, Shell Development Company, Houston, Texas

PALEONTOLOGY AND STRATIGRAPHY

1. DISTRIBUTION OF RECENT FORAMINIFERA, WESTERN UNITED STATES AND NORTHWEST MEXICO, Robert R. Lankford, Pan American Petroleum Corporation, Houston, Texas
2. DISTRIBUTION OF LIVING PLANKTONIC FORAMINIFERA IN THE NORTHEAST PACIFIC OCEAN, A. Barrett Smith, University of Washington, Seattle, Washington
3. UPPER CRETACEOUS FORAMINIFERA ZONES, VANCOUVER ISLAND, BRITISH COLUMBIA, CANADA, Alan McGugan, Consultant, Calgary, Alberta
4. PLANKTONIC FORAMINIFERA AND THE CRETACEOUS-TERTIARY BOUNDARY,—THE MISSING LINK,? William A. Berggren, University of Stockholm, Stockholm, Sweden
5. MICROFAUNA OF BASAL LIMESTONES OF THE MORRISON (JURASSIC) OF COLORADO, Daniel J. Jones* and C. N. Holmes, University of Utah, Salt Lake City, Utah
6. OSTRACODA AND CLADOCERA OF THE LATE TERTIARY HUMBOLDT FORMATION, NORTHEASTERN NEVADA, Kendell A. Dickinson* and Frederick M. Swain, University of Minnesota, Minneapolis Minnesota
7. FIRST GLIMPSE OF CLAM SHRIMP SPECIATION IN LEONARDIAN SMALL POND SITUATIONS, Paul Tasch, University of Wichita, Wichita, Kansas
8. INTERNAL MORPHOLOGY OF THE MISSISSIPPIAN BLASTOID "ORBITREMITES," Harold H. Beaver, Humble Oil & Refining Company, Houston, Texas
9. SOME PENNSYLVANIAN AND PERMIAN RUGOSE CORALS, GLASS MOUNTAINS, TEXAS, Charles A. Ross* and June Phillips Ross, Illinois Geological Survey, Urbana, Illinois
10. INSOLUBLE RESIDUES FOR PALEONTOLOGIC AND STRATIGRAPHIC RESEARCH, H. A. Ireland, University of Kansas, Lawrence, Kansas
11. DEVONIAN CAVITY FILLINGS IN SUBSURFACE SILURIAN CARBONATES OF WEST TEXAS, Fred L. Pierce, Humble Oil and Refining Company, Houston, Texas

* Denotes speaker.

12. A Biofacies Zonation of the Woodford Formation, L. R. Wilson* and J. B. Urban, University of Oklahoma, Norman, Oklahoma
13. Kittanning Paleogeography in Western Pennsylvania, John C. Ferm,* Louisiana State University, Baton Rouge, Louisiana, and E. G. Williams, The Pennsylvania State University, University Park, Pennsylvania
14. Stratigraphy of the Rocky Mountain Group (Permo-Carboniferous), Banff Area, Alberta, Alan McGugan, Consultant, Calgary, Alberta
15. Paleoecology of the Choctawhatchee Deposits (Late Miocene) at Alum Bluff, Florida, Jules R. DuBar* and Donald W. Beardsley, University of Houston, Houston, Texas
16. Stratigraphy and Petrology of Difunta Group, Parras Basin, Coahuila and Nuevo Leon, Mexico, Grover E. Murray* and John C. Ferm, Louisiana State University, Baton Rouge, Louisiana
17. Lithofacies and Sedimentary-Paleogeographic Analysis of the Los Angeles Repetto Basin, J. E. Slosson, Los Angeles Valley College, Van Nuys, California

SEDIMENTATION AND SEDIMENTARY PETROLOGY

1. Laboratory Synthesis of Sedimentary Rocks, Sherman A. Wengerd, University of New Mexico, Albuquerque, New Mexico
2. Depositional Environment of the Dakota Sandstone of Southeastern Colorado, Donald G. McCubbin, The Ohio Oil Company, Littleton, Colorado
3. Montchauve Group, Product of Pennsylvanian Epeirogeny in Wyoming, Thomas W. Todd, California Research Corporation, La Habra, California
4. Sedimentary Petrology and Sedimentation of the Miocene Browns Park Formation, Wayne A. Chisholm,* The Pure Oil Company, Crystal Lake, Illinois; Marion J. Bergin, U. S. Geological Survey, Washington, D. C.; George E. Prichard, U. S. Geological Survey, Denver, Colorado
5. Rapid Methods for Dimensional Grain Orientation Measurements, W. Zimmerle, Deutsche Erdöl—Aktiengesellschaft, Erdölwerke Wietze, Kreise Celle, Germany; L. C. Bonham,* California Research Corporation, La Habra, California
6. Distinction Between Dune, Beach, and River Sands from Their Textural Characteristics, Gerald M. Friedman, Pan American Petroleum Corporation, Tulsa, Oklahoma
7. Petrology of two Turbidite Formations, Gerald V. Middleton, McMaster University, Hamilton, Ontario
8. Quartz and Feldspar Content of Sands from the South Platte, Platte, and Missouri Rivers, John R. Hayes, Colorado School of Mines, Golden, Colorado
9. Problems of Diffusion and Accumulation of Oil, Robert Weynschenk, Innsbruck, Austria
10. Character of Deep Water Sand Layers, Francis P. Shepard, Scripps Institution of Oceanography, University of California, La Jolla, California
11. Sedimentary Characteristics of Three Types of Recent Sand Bodies, Paul M. Miller, Jersey Production Research Company, Tulsa, Oklahoma
12. Environmental Control of Sediment Distribution in Estuaries, Robert E. Burns, University of Washington, Seattle, Washington
13. Dispersal of Clay Sediment in the Rappahannock River, Bruce W. Nelson, Virginia Polytechnic Institute, Blacksburg, Virginia
14. Sedimentation in a High Energy, Embayed, Continental Shelf Environment, Joe S. Creager, University of Washington, Seattle, Washington
15. Coastal Sediments of Northern Oregon, John V. Byrne, Oregon State College, Corvallis, Oregon
16. Changes in Sedimentation Environments over the Southwest Florida Shelf as Indicated by Interstitial Water Chlorinity, David W. Scholl, Stanford University, Stanford, California
17. Characteristics of Sedimentary Environments in West Florida Bays, D. S. Gorsline,* H. G. Goodell, J. W. Kofoed, Florida State University, Tallahassee, Florida
18. Volcanic Ash Deposits in the Gulf of Alaska, Y. R. Nayudu, University of Washington, Seattle, Washington
19. The Petrography of Pennsylvanian Chert Breccias and Conglomerates, Rocky Mountain Group, Banff, Alberta, June E. Rapson, Shell Oil Company, Calgary, Alberta
20. Ripple Marks Cut on Limestone Pebble Conglomerates, John C. Osmond, Consultant, Salt Lake City, Utah
21. Sparite—Its Occurrence and Origin, B. Mamet and W. B. N. Berry,* University of California, Berkeley, California
22. Open-Space Calcite in Upper Pennsylvanian Limestones, John W. Harbaugh, Stanford University, Stanford, California
23. The Alacran Reef Complex of the Campeche Bank, Louis S. Kornicker, Office of Naval Research, Washington, D. C.; Donald W. Boyd,* University of Wyoming, Laramie, Wyoming

* Denotes speaker.

24. Textural and Porosity Studies of Some Devonian Dolomite and Limestone Reef Complexes, Edmonton and Swan Hills Areas, Alberta, G. E. Thomas* and H. S. Rhodes, Consultants, Calgary, Alberta
25. Petrography of Mississippian (Borden) Crinoidal Limestones at Stobo, Indiana, Albert V. Carozzi* and J. G. William Soderman, University of Illinois, Urbana, Illinois
26. Eastern Great Basin Paleozoic Carbonates—Techniques and Classification, Harold J. Bissel, Brigham Young University, Provo, Utah
27. Ordovician (?) Carbonates of Western Newfoundland and Their Classification, William M. Merrill, Syracuse University, Syracuse, New York

SYMPOSIUM ON CLASSIFICATION OF CARBONATE ROCKS

1. Biologic, Genetic, and Utilitarian Aspects of Limestone Classification, Dan E. Feray,* Southern Methodist University, Dallas, Texas; Edward Heuer, Texas Christian University, Fort Worth, Texas; Willis G. Hewatt, Texas Christian University, Fort Worth, Texas
2. Carbonate Rock Types, M. W. Leighton* and Charles Pendexter, Jersey Production Research Company, Tulsa, Oklahoma
3. Spectral Subdivision of Limestone Types, Robert L. Folk, University of Texas, Austin, Texas
4. Energy Index for Limestone Interpretation and Classification, W. J. Plumley,* G. A. Risley, R. W. Graves, Jr.,† and M. E. Kaley, California Research Corporation, La Habra, California
5. Skeletal Limestone Classification, Henry F. Nelson and Charles Wm. Brown,* Socony Mobil Oil Company, Inc., Field Research Laboratory, Dallas, Texas; John H. Brineman, Argus Petroleum Company, Guatemala City, Guatemala
6. Classification of Modern Bahamian Carbonate Sediments, John Imbrie, Columbia University, New York, New York; E. G. Purdy,* The Rice Institute, Houston, Texas
7. Classification of Carbonate Rocks According to Depositional Fabric, R. J. Dunham, Shell Development Company, Houston, Texas
8. Classification and Petrology of Arabian Upper Jurassic Carbonate Reservoir Rocks, R. W. Powers, Arabian American Oil Company and Yale University, New Haven, Connecticut

* Denotes speaker.
† Present address, Lion Oil Company, Denver, Colorado.

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*ACOSTA-GIMENEZ, JOSE T., Calle Goss No. 317, Vibora, Havana, Cuba
*ADAMS, EMMETT R., Shell Oil Co., Box 1817, Jackson, Miss.
ADAMS, JAMES B., Pan American Petr. Corp., Lubbock, Tex.
ADAMS, JOHN EMERY, Standard Oil Co. of Texas, Box 1660, Midland, Tex.
*ADAMS, JOHN K., Univ. of Delaware, Newark, Del.
ADDICOTT, WARREN O., Mobil Oil Co., 1825 Nineteenth St., Bakersfield, Calif.
ADENT, WILLIAM A., 926 J Bldg., Sacramento, Calif.
AKERS, WILBURN H., The California Co., The California Co. Bldg., New Orleans, La.
ALBERS, CHARLES C., Pan American Petr. Corp., Box 14085, Houston, Tex.
ALBRITTON, CLAUDE C., JR., Southern Methodist Univ., Dallas, Texas.
ALDEN, JOHN H., JR., Amerada Petr. Corp., Drawer 601, Durango, Colo.
ALEXANDER, C. I., Mobil Oil Co., Box 900, Dallas, Tex.
ALEXANDER, W. H., JR., U. S. Geol. Survey, Box 846, Dumas, Tex.
ALLAN, JAMES F., Tennessee Gas Transmission Co., Box 105, Calgary, Alta., Canada
ALLEN, JOHN L., 6808 Avalon, Dallas, Tex.
*ALLEN, JOHN R. L., Dept. of Geology, The University, London Rd., Reading, Berks., England
‖ALLEN, PERCIVAL, The University, Reading, Berks, England
*ALLING, HAROLD L., 155 W. Jefferson Rd., Pittsford, N. Y.
ALLISON, EDWIN C., San Diego State College, San Diego, Calif.
ALLISON, JAMES M., Box 299, Salem, Ill.
ALMGREN, ALVIN A., Union Oil Co. of California, Box 613, Bakersfield, Calif.
ALVAREZ, MANUEL, JR., Tamaulipas 147, Col. Condesa, Mexico City, Mexico
*ALVORD, RICHARD PAUL, 229 Dwight St., New Haven, Conn.
AMBLER, HAROLD L., Farmers Union Central Exchange, Inc., Box 2520, Billings, Mont.
*AMSBURY, DAVID L., Shell Devel. Co., Box 481, Houston, Tex.
AMSDEN, THOMAS W., State Geol. Survey, Univ. of Oklahoma, Norman, Okla.
*AMSTUTZ, G. C., Missouri School of Mines, Rolla, Mo.
ANDERSEN, HAROLD V., Louisiana State Univ., Baton Rouge, La.
ANDERSON, HOWARD T., Iranian Oil Expl. & Prod. Co., Box 1065, Tehran, Iran
ANDERSON, IRVIN J., Box 1457, Oil Center Sta., Lafayette, La.
*ANDERSON, MITZI ANNETTE, Shell Devel. Co., Box 481, Houston, Tex.
ANDERSON, NORMAN R., College of Puget Sound, Tacoma, Wash.
*ANDERSON, ROBERT W., Rt. 2, Box 382, Springfield, Ore.
ANDREWS, FRANKLIN, Arrowhead Geoservices, Box 622, Tallahassee, Fla.
ANDREWS, LESLIE W., Lion Oil Co., 1310 Denver Club Bldg., Denver, Colo.
ANDRICHUK, JOHN M., 31 Roselawn Crescent, Calgary, Alta., Canada
ANISGARD, HARRY W., Humble Oil & Refg. Co., Carter Div., Box 318, Billings, Mont.
*APPLIN, ESTHER R., 804 Valencia St., Jackson, Miss.
ARANT, W. H., c/o Sam Haught, Rt. 2, Longview, Tex.
ARELLANO, A. R. V., Apt. 19066, Mexico D.F., Mexico
ARMSTRONG, AUGUSTUS K., Portland State College, Portland, Ore.
ARMSTRONG, BOBBY L., 1608 Beverly Dr., Wichita Falls, Tex.
ARMSTRONG, URSEL S., Shell Oil Co., Box 691, Ventura, Calif.
ARNAL, ROBERT E., 1813 Clare Ct., San Jose, Calif.
*ARNI, PAUL, Mobil Oil of Canada Ltd., Box 690, Tripoli, Libya
*ARONOW, SAUL, Lamar State College of Technology, Beaumont, Tex.
ARPER, WILLIAM B., JR., Texas Technological College, Lubbock, Tex.
ARTUSY, RAYMOND L., 3419 Cornell, Dallas, Tex.
ASCHENBRENNER, BERT C., Autometric Corp., Paramount Bldg., Times Sq., New York, N. Y.
*ASLIN, C. J., Dept. of Geology, Univ. of Leicester, Leicester, England
ATKINSON, ERIC, 19 Gladys Ridge Road, Calgary, Alta., Canada
AVES, CHARLES A., R.F.D. 372A, Spring, Tex.
*AVIAS, JACQUES, Laboratoire de Geologie, 31 Rue de l'Universite, Montpellier, France
*AYALA-CASTANARES, AGUSTIN, Inst. Geologia, Universidad Nacional de Mexico, Apt. 24706, Mexico City, Mexico
AZMON, EMANUEL, 4129 Buckingham Rd., Los Angeles, Calif.

BAINTON, JACK D., Standard Oil Co. of California, Box 278, Oildale, Calif.
BAIRD, D. W., Oasis Oil Co. of Libya, Box 377, Tripoli, Libya
BAKER, DONALD R., Ohio Oil Co., Box 269, Littleton, Colo.
BAKKER, DANIEL, Shell Oil Co., Box 2240, Abilene, Tex.

BALDWIN, E. JOAN, 701 Thirty-first St., Manhattan Beach, Calif.
BALDWIN, EWART M., Univ. of Oregon, Eugene, Ore.
*BALK, CHRISTINA LOCHMAN, New Mexico Inst. of Mining & Technology, Socorro, N. Mex.
BALLMANN, DONALD L., St. Joseph's College, Rensselaer, Ind.
BANDY, ORVILLE L., Univ. of Southern California, Los Angeles, Calif.
BARBAT, WILLIAM F., Standard Oil Co. of California, 225 Bush St., San Francisco, Calif.
*BARGHOORN, ELSO S., Harvard Univ., Cambridge, Mass.
BARKELL, C. A., Shell Oil Co., 1055 Dexter Horton Bldg., Seattle, Wash.
*BARKER, R. WRIGHT, Shell Devel. Co., Box 481, Houston, Tex.
BARLOW, WILLIAM R., Standard Oil Co. of California, Box 278, Oildale, Calif.
*BARNES, CHARLES W., 113 N. Garfield, Moscow, Ida.
BARNES, VIRGIL E., Bureau of Economic Geology, Box 8022, Austin, Tex.
*BARTHEL, K. WERNER, Zugspitzstr. 14, Furstenfeldbruck, Bavaria, Germany
*BASSLER, R. S., U. S. Natl. Museum, Washington, D. C.
*BATES, JOHN D., Coastal Petr. Co., 205 Petroleum Bldg., Tallahassee, Fla.
*BATHURST, R. G. C., The University, Liverpool, England
*BATTEN, R. WESLEY, Frederick College, Portsmouth, Va.
*BATTEN, ROGER L., Univ. of Wisconsin, Madison, Wis.
BAYER, THOMAS N., Macalester College, St. Paul, Minn.
BAYLES, ROBERT E., Hope Natural Gas Co., 445 W. Main St., Clarksburg, W. Va.
*BE, ALLAN W. H., Lamont Geol. Observatory, Palisades, N. Y.
BEALES, FRANCIS WILLIAM, Univ. of Toronto, Toronto, Ont., Canada
BEAVER, HAROLD H., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
*BEBOUT, DON G., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
BECK, FRANK R., Univ. of Colorado, Boulder, Colo.
BECK, R. STANLEY, 621 Truxtun, Bakersfield, Calif.
*BECKER, HERMAN F., New York Botanical Garden, Bronx Park, New York, N. Y.
BECKER, LEROY E., Creole Petr. Corp., Maracaibo, Venezuela, S.A.
*BECKMANN, JEAN-PIERRE, Pan American International Oil Co., Pan American Bldg., Tehran, Iran
BECKWITH, ROBERT W., Union Oil Co. of California, Box 613, Bakersfield, Calif.
BEERS, ROLAND F., Box 1019, Troy, N. Y.
BELDING, HERBERT F., Standard Oil Co. of New Jersey, 30 Rockefeller Plaza, New York, N. Y.
BELL, OLIN G., 5519 Jackson St., Houston, Tex.
*BELL, PETER M., Harvard Univ., Cambridge, Mass.
BELL, W. CHARLES, Univ. of Texas, Austin, Tex.
BELLIS, WILLIAM H., Univ. of Oklahoma, Norman, Okla.
BENDA, WILLIAM K., Florida State Univ., Tallahassee, Fla.
*BENFER, NEIL A., McGraw-Hill Encyclopedia of Science and Technology, Charlottesville, Va.
BENNISON, ALLAN P., 4328 E. Fourth Pl., Tulsa, Okla.
BENTZ, ALFRED, Wiesenstr. 72, Hannover, Germany
BERGEN, FRED W., JR., Shell Oil Co., Box 3397, Los Angeles, Calif.
BERGER, WALTER R., JR., Berger & Berger, 236 Capitol Bldg., Midland, Tex.
BERGGREN, WILLIAM A., Princeton Univ., Princeton, N. J.
BERMUDEZ, PEDRO J., Direccion de Geologia, Ministerio de Minas e Hidrocarburos, Caracas, Venezuela, S. A.
BERNARD, HUGH A., Shell Devel. Co., Box 481, Houston, Tex.
BERRY, KEITH D., Standard Oil Co. of California, Box 278, Oildale, Calif.
BERRYHILL, HENRY L., JR., U. S. Geol. Survey, Federal Center, Denver, Colo.
*BERSHAD, SUZANNE F., U. S. Navy Hydrographic Office, Washington, D. C.
*BERSIER, ARNOLD, Musee Geologique, Lausanne, Switzerland
*BETTINGER, CHARLES E., 835 Iowa Ave., Aurora, Ill.
BEVERIDGE, ALEXANDER J., Canberra Oil Co. Ltd., Calgary, Alta., Canada
*BHATTACHARYA, NITYANANDA, D. 33/14, Khalishpura, Varanasi-1, India
*BIEBER, CHARLES L., DePauw Univ., Greencastle, Ind.
BIEL, RALPH, Esso Standard (Libya) Inc., Box 385, Tripoli, Libya
BIESIOT, PETER G., JR., U.S.O.M.-K., P.G.B.A., A.P.O. 271, c/o Postmaster, New York, N. Y.
*BIGARELLA, JOAO JOSE, Instituto de Geologia, Universidade do Parana, Caixa Postal 756, Curitiba, Brazil, S. A.
*BIJVANK, GERHARD, Calle de la Paz 14, Vitoria, Alava, Spain
BILLINGSLEY, HAROLD RAY, Box 1467, Dallas, Tex.
BILLMAN, HAROLD G., Union Oil Co. of Spain, Apt. 445, Calle Galo Ponte #12, Las Palmas de Gran Canaria, Canary Islands
BINKLEY, WILLIAM G., 321-C St., Anchorage, Alaska
BISSELL, HAROLD J., Brigham Young Univ., Provo, Utah
*BLACKMON, PAUL D., U. S. Geol. Survey, Federal Center, Denver, Colo.
BLAKE, OLIVER D., 731 Bayview Pl., Laguna Beach, Calif.
*BLATT, HARVEY, Univ. of California, Los Angeles, Calif.
BLYTHE, JACK G., Univ. of Wichita, Wichita, Kan.
BOARDMAN, DONALD C., Univ. of Peshawar, Peshawar, West Pakistan
BOARDMAN, RICHARD S., U. S. Natl. Museum, Washington, D. C.

*BOLIN, EDWARD J., Caltex Pacific Oil Co., 41 A Robinson Rd., Singapore, Malaya
*BOND, GEOFFREY, National Museum of Southern Rhodesia, Box 240, Bulawayo, Southern Rhodesia
BONHAM, LAWRENCE C., California Research Corp., Box 446, La Habra, Calif.
BORDEAU, KENNETH V., 1335 Jenkins, Norman, Okla.
BORDEN, EUGENE W., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
*BOSTWICK, DAVID A., Oregon State College, Corvallis, Ore.
BOUCOT, ARTHUR J., Massachusetts Inst. of Technology, Cambridge, Mass.
*BOUMA, ARNOLD HEIKO, Geologisch Institute, Oude Gracht 320, Utrecht, Netherlands
‖BOURCART, J. J., Laboratoire de Geol., sous-marin de la Faculte des Sciences de Paris, 1 rue Victor-Cousin, Paris, France
BOURGEOIS, FEODOR, Aramco, Box 1177, Dhahran, Saudi Arabia
BOURN, OSCAR B., Standard Oil Co. of Texas, Box 2087, Amarillo, Tex.
*BOWLER, JAMES M., Dept. of Geology, Univ. of Melbourne, Melbourne, Australia
*BOWMAN, ROBERTA R., 1030 Ohio Ave., Lemoyne, Pa.
BOYD, DONALD W., Univ. of Wyoming, Laramie, Wyo.
BOZANIC, DAN, Guatcal, Box 1307, Guatemala City, Guatemala, C. A.
BRABB, EARL EDWARD, 53 Callie Lane, Menlo Park, Calif.
*BRADEN, WILLIAM J., Texaco Inc., Box 3109, Midland, Tex.
BRADFIELD, HERBERT H., 4835 N. Lindhurst, Dallas, Tex.
BRADLEY, DANIEL A., Aurora Explorations Ltd., 5803 Cote Des Neiges, Suite 204A, Montreal, Que., Canada
BRADLEY, JOHN S., Atlantic Refg. Co., Box 2819, Dallas, Tex.
*BRADLEY, WILLIAM F., State Geol. Survey, Univ. of Illinois, Urbana, Ill.
BRADLEY, W. H., U. S. Geol. Survey, Washington, D. C.
BRADY, WILLIAM B., Union Oil Co. of California, 709–711 Eighth Ave., W., Calgary, Alta., Canada
BRAMLETTE, M. N., Scripps Institution of Oceanography, La Jolla, Calif.
BRAMLETTE, W. A., Humble Oil & Refg. Co., Carter Div., Box 801, Tulsa, Okla.
BRAND, JOHN PAUL, Texas Technological College, Lubbock, Tex.
BRANSON, CARL C., State Geol. Survey, Univ. of Oklahoma, Norman, Okla.
BRANSON, HERBERTA VAN PELT, Shell Oil Co., 1200 First Natl. Bldg., Oklahoma City, Okla.
BRANTLY, J. E., JR., Caixa Postal 1409, Rio de Janeiro, Brazil, S. A.
BRAUNSTEIN, JULES, Shell Oil Co., Box 193, New Orleans, La.
*BREAUX, JAMES E., Louisiana State Univ., Baton Rouge, La.
BREHM, CLARENCE E., Box 618, Mt. Vernon, Ill.
*BRENNER, GILBERT J., Pennsylvania State Univ., University Park, Pa.
*BRICE, JAMES C., Washington Univ., St. Louis, Mo.
BRIGGS, LOUIS ISAAC, JR., Univ. of Michigan, Ann Arbor, Mich.
BRIGHT, ANNA LOU, 2522 Goldsmith, Houston, Tex.
BRISTOL, HUBERT M., 902 S. Fifth St., Effingham, Ill.
BRITT, HARRY M., 5017 Tawney, Amarillo, Tex.
BRIXEY, AUSTIN D., JR., Sinclair Oil & Gas Co., Fort Worth Natl. Bank Bldg., Fort Worth, Tex.
*BROCK, JEROME A., Gulf Oil Corp., Box 1635, Houston, Tex.
BROCKHOUSE, ROBERT B., Shell Oil Co., Box 193, New Orleans, La.
BROGDON, DEWEY R., Ohio Oil Co., Box 1210, Tyler, Tex.
BROGNON, GEORGES, C. P. 1627, Luanda, Angola
BROIN, THAYNE LEO, Cities Service Res. & Devel. Co., 920 E. Third St., Tulsa, Okla.
BROOKLEY, A. C., JR., International Petroleum (Colombia) Ltd., Apt. Aereo 3533, Bogota, Colombia, S.A.
BROOKS, JAMES A., Southern Methodist Univ., Dallas, Tex.
BROOKS, RICHARD L., Richfield Oil Corp., 5900 Cherry Ave., Long Beach, Calif.
*BROPHY, JOHN A., North Dakota Agricultural College, Fargo, N. Dak.
BROUWER, JOHANNES, Narcislaan 323, The Hague, Netherlands
BROWN, DWIGHT M., JR., Skelly Oil Co., Box 993, Midland, Tex.
*BROWN, GRAHAM ARCHDALL, 12 Riverview Rd., North Balwyn, Victoria, Australia
BROWN, PHILIP R., 44 Burdett Rd., Waterloo, Liverpool, England
*BROWNE, IDA A., Dept. of Geology, Univ. of Sydney, Sydney, N.S.W., Australia
BROWNSON, ERNEST M., Shell Oil Co., Box 1347, Shreveport, La.
BRYANT, DONALD L., Curso de Geologia, Petrobras, Caixa Postal 670, Salvador, Brazil, S. A.
*BUBB, JOHN NEAL, Indiana Univ., Bloomington, Ind.
BUCK, CHARLES E., Skelly Oil Co., Box 2187, Amarillo, Tex.
BUFFINGTON, EDWIN C., U. S. Navy Electronics Lab., San Diego, Calif.
BUNCH, ROSELLA L., 5700 Lockton Lane Mission, Kan.
BURGERS, WILLEM, 5024 Second St., N.W., Calgary, Alta., Canada
BURGESS, Jack D., Humble Oil & Refg. Co. Carter Div., Box 318, Billings, Mont.
BURMA, BENJAMIN H., California Exploration Co., 320 Market St., San Francisco, Calif.
BURNETT, WILLIAM M., Sunray Mid-Continent Oil Co., Box 2250, Casper, Wyo.
*BURNS, ROBERT E., Univ. of Washington, Seattle, Wash.
BUROLLET, PIERRE F., Compagnie des Petroles Total (Libye), Box 984, Tripoli, Libya

BURROUGHS, RICHARD LEE, Lion Oil Co., 1310 Denver Club Bldg., Denver, Colo.
BURSCH, JACOBUS GEORGE, Compagnie des Petroles France-Afrique, Cite Sainte Agnes, Batiment A No. 3B, Rue Albe, Marseille, France
BUSCH, DANIEL A., 833 Mayo Bldg., Tulsa, Okla.
BUSH, JAMES, General Electric Co., 208 S. Geddes St., Syracuse, N. Y.
BUTLER, ELIZABETH M., State Geol. Survey, Louisiana State Univ., Baton Rouge, La.
BUTLER, ROBERT JAMES, Humble Oil & Refg. Co., Box 318, Billings, Mont.
BYRNE, JOHN V., Oregon State College, Corvallis, Ore.

CADIGAN, ROBERT A., U. S. Geol. Survey, Federal Center, Denver, Colo.
CALDWELL, ELEANOR, Humble Oil & Refg. Co., Box 1390, Hattiesburg, Miss.
*CALEMBERT, LEON M. C., Univ. of Liege, Liege, Belgium
CALLENDER, DEAN L., 3605 N. W. Twenty-fourth St., Oklahoma City, Okla.
CALVERT, STEPHEN E., Scripps Institution of Oceanography, La Jolla, Calif.
CAMACHO, ENRIQUE, Shell Oil Co., Box 1636, Oil Center Sta., Lafayette, La.
CAMPBELL, A. RICHARD, Shell Devel. Co., Box 481, Houston, Tex.
CAMPBELL, ANGUS S., Oasis Oil Co. of Libya, Box 377, Tripoli, Libya
CAMPBELL, CHARLES V., Humble Oil & Refg. Co., Carter Div., Box 801, Tulsa, Okla.
*CAMPBELL, DAVID G., Bechtel Corp., 537 Market St., San Francisco, Calif.
CAMPBELL, JOHN ARTHUR, Colorado State Univ., Fort Collins, Colo.
*CARIA, IDA COMASCHI, Via Sonnino 99, Cagliari, Italy
*CARL, JAMES D., Univ. of Illinois, Urbana, Ill.
*CARLOS, ABELARDO, Republic Resources & Devel. Corp., 410 Rosario St., Manila, Philippines
*CARLSON, CURTIS CRAIG, 16688 Magneson Loop, Los Gatos, Calif.
CARLSON, STANLEY A., Richfield Oil Corp., Box 147, Bakersfield, Calif.
CARMODY, ROBERT A., 1636 Gentry Dr., Wichita, Kan.
*CAROZZI, ALBERT V., Univ. of Illinois, Urbana, Ill.
CARPENTER, GENE C., Earth Science Labs., Inc., Box 66, Campus Sta., Cincinnati, Ohio
*CARRIGY, MAURICE A., Research Council of Alberta, Eighty-seventh Ave., and One Hundred Fourteenth St., Edmonton, Alta., Canada
*CARROLL, DOROTHY, U. S. Geol. Survey, Washington, D. C.
CARROLL, NEIL P., Texaco Inc., 3350 Wilshire Blvd., Los Angeles, Calif.
*CARSOLA, ALFRED J., Anti-Submarine Systems, Lockheed Aircraft Corp., Burbank, Calif.
CARSON, CARLTON M., Box 26, Ventura, Calif.
CARSTENS, FRED D., 2815 Morrison St., Houston, Tex.
CARY, CHARLES W., Union Oil Co. of California, Box 613, Bakersfield, Calif.
CASTER, KENNETH E., Univ. of Cincinnati, Cincinnati, Ohio
CATE, ADDISON S., State Geol. Survey, 401 State Office Bldg., Pittsburgh, Pa.
CATHCART, JAMES B., U. S. Geol. Survey, Federal Center, Denver, Colo.
CAZEAU, CHARLES J., Clemson College, Clemson, S. Car.
CHAMNEY, T. POTTER, Shell Oil Co., Box 100, Calgary, Alta., Canada
*CHAPPARS, MICHAEL S., U. S. Geol. Survey, Washington, D. C.
CHATHAM, WALTER, JR., 7416 Conrad Rd., Alexandria, Va.
*CHAVE, KEITH E., Lehigh Univ., Bethlehem, Pa.
CHEETHAM, ALAN H., Louisiana State Univ., Baton Rouge, La.
CHEN, CHIH SHAN, Northwestern Univ., Evanston, Ill.
CHERNOFF, CHARLIE N., Chevron Oil Co., 205 Fourth St., N.E., Calgary, Alta., Canada
*CHIJI, MANZO, Osaka Municipal Museum of Natural History, Utsubo Park, Nishi-ku, Osaka, Japan
CHILINGAR, GEORGE V., 101 S. Windsor Blvd., Los Angeles, Calif.
CHOQUETTE, PHILIP W., Ohio Oil Co., Box 269, Littleton, Colo.
*CHRISTENSEN, E. W., Standard Oil Co. of California, Box 278, Oildale, Calif.
CHRONIC, JOHN, Univ. of Colorado, Boulder, Colo.
CHUN, HAROLD A., 5215 Holly St., Bellaire, Tex.
CHURCH, CLIFFORD C., 15 Montrose St., Bakersfield, Calif.
*CIRY, RAYMOND MAURICE, Faculte des Sciences, 51 Rue Monge, Dijon, Cote d'Or, France
*CLARK, DANA KENT, Shell Oil Co., 112 Cherry St., Seattle, Wash.
CLARK, DAVID L., Brigham Young Univ., Provo, Utah
CLARK, JOHN W., 813 First Natl. Bank Bldg., Dallas, Tex.
*CLARK, JOSEPH CLYDE, Apt. 10A, Escondido Village, Stanford, Calif.
CLARK, ROBEY H., Mobil Oil Co., 312 Pere Marquette Bldg., New Orleans, La.
CLARKSON, LOUISE FREEMAN, 242 Circle Dr., Corpus Christi, Tex.
CLEMENTS, THOMAS, Univ. of Southern California, Los Angeles, Calif.
CLIFTON, R. L., 1703 E. Maple St., Enid, Okla.
CLINE, Franklin L., JR., Shell Oil Co., Box 3397, Terminal Annex, Los Angeles, Calif.
CLINE, L. M., Univ. of Wisconsin, Madison, Wis.
CLUTE, WALKER S., 309 Havenstrite Oil Bldg., 811 W. Seventh St., Los Angeles, Calif.
COBBAN, WILLIAM A., U. S. Geol. Survey, Federal Center, Denver, Colo.
*COCH, NICHOLAS KYROS, Univ. of Rochester, Rochester, N. Y.
*COCHRAN, JOHN A., Pennsylvania State Univ., University Park, Pa.
COHEE, GEORGE V., U. S. Geol. Survey, Washington, D. C.
COLLE, JACK, 911 San Jacinto Bldg., Houston, Tex.
*COLLINS, DONALD NEAL, Humble Oil & Refg. Co., Box 17, Rawlins, Wyo.

*COLLINS, ROBERT J., 3012 Clifford Dr., Whitney Heights, Metairie, La.
COLLINSON, CHARLES W., State Geol. Survey, Univ. of Illinois, Urbana, Ill.
*COLOM, GUILLERMO, Isabel II no. 23, Soller, Balearic Islands, Spain
COLQUHOUN, DONALD J., Univ. of South Carolina, Columbia, S. Car.
*CONNALLY, G. GORDON, 1514 K Spartan Village, East Lansing, Mich.
CONNIFF, JOHN J., Shell Oil Co., Ventura, Calif.
CONNOLLY, FRANK T., Shell Devel. Co., Box 481, Houston, Tex.
*CONOLLY, JOHN R., Geology Dept., University of New South Wales, Sydney, Australia
CONREY, BERT L., 645 Ultimo Ave., Long Beach, Calif.
CONSELMAN, FRANK B., 514 Petroleum Bldg., Abilene, Tex.
CONSIGLIO, LOUIS A., 1035 S. Menlo Ave., Los Angeles, Calif.
COOK, THEODORE D., Shell Oil Co., Box 1861, Corpus Christi, Tex.
COOLEY, DOUGLAS R., Gulf Oil Corp., Box 9010, Amarillo, Tex.
COOPER, CHALMER L., U. S. Geol. Survey, Washington, D. C.
COOPER, WILLIAM CLINTON, Standard Oil Co. of California, Box 606, La Habra, Calif.
CORDELL, R. J., Sun Oil Co., 503 N. Central Expressway, Richardson, Tex.
COREY, W. H., Continental Oil Co., 1137 Wilshire Blvd., Los Angeles, Calif.
CORGAN, JAMES X., 937A N. Osage Dr., Tulsa, Okla.
CORNELL, JAMES R., Pan American Petr. Corp., Box 487, Farmington, N. Mex.
‖CORRENS, CARL W., Mineralogische Institut, Universitat Gottingen, Gottingen, Germany
CORYELL, H. N., 3477 Far Hills Ave., Dayton, Ohio
COWPER, N. W., Tennessee Gas Transmission Co., Box 105, Calgary, Alta., Canada
COX, BEN B., Box 237, Cheswick, Pa.
COX, MARGARET MCKENZIE, Richfield Oil Corp., 5900 Cherry Ave., Long Beach, Calif.
CRAFT, JESSE L., JR., Green Valley Manor, Rt. 2, Lafayette, N. Y.
*CRAIG, DONALD C., Geology Dept., University of New South Wales, Sydney, Australia
CRAM, IRA H., Continental Oil Co., 30 Rockefeller Plaza, New York, N. Y.
CRANE, MARILYN, Humble Oil & Refg. Co., Box 1271, Corpus Christi, Tex.
*CRAWFORD, FRANK DOUGLAS, Union Oil Co. of California, Box 7600, Los Angeles, Calif.
CREAGER, J. S., Univ. of Washington, Seattle, Wash.
CREAGER, NANCE G., Continental Oil Co., Rowley Bldg., Artesia, N. Mex.
*CRESPIN, IRENE, Bureau of Mineral Resources, Turner Hostel, Canberra, A. C. T., Australia
CROCKER, MARVIN C., JR., Texas A & M College, College Station, Tex.
CROMBIE, GORDON P., 237 Seventh Avenue, W., Calgary, Alta., Canada
CRONEIS, CAREY, Rice Univ., Houston, Tex.
*CROOK, KEITH A. W., Univ. of Alberta, Edmonton, Alta., Canada
CROPP, FREDERICK W., III, Univ. of Illinois, Urbana, Ill.
CROSS, AUREAL T., Pan American Petr. Corp., Box 591, Tulsa, Okla.
CROUCH, ROBERT W., 3427 Broadmead, Houston, Tex.
CROWL, G. H., Ohio Wesleyan Univ., Delaware, Ohio
CRUSE, JOHN S., Arabian American Oil Co., Dhahran, Saudi Arabia
CULBERTSON, THOMAS M., Union Oil Co. of Calif., 619 W. Texas, Midland, Tex.
CULBERTSON, WILLIAM C., U. S. Geol. Survey, Federal Center, Denver, Colo.
CULLINS, HENRY L., JR., Continental Geophysical Co., Oklahoma City, Okla.
CULP, EUGENE F., 912 W. Wilson St., Norman, Okla.
CUMMINGS, JON CLARK, Oregon State College, Corvallis, Ore.
CURRAY, JOSEPH R., Scripps Institution of Oceanography, La Jolla, Calif.
CURTIS, DORIS M., Shell Oil Co., Box 127, Metairie, La.
CUVILLIER, JEAN, Lab. de Geologie Appliquee, 191 rue Saint Jacques, Paris, France

DAETWYLER, CALVIN C., 1273 W. Chase Ave., El Cajon, Calif.
DAILEY, DONALD H., Richfield Oil Corp., 5900 Cherry Ave., Long Beach, Calif.
DALEON, BENJAMIN A., 12 Batay Rd., Cubao Heights, Quezon City, Philippines
DALLY, JESSE L., Pan American Petr. Corp., Box 1410, Fort Worth, Tex.
DAMERON, WYLLIE F., B.B.M. Drilling Co., 206 West Bldg., Midland, Tex.
DANEHY, EDWARD A., Southern Pacific Co., 65 Market St., San Francisco, Calif.
*D'ANGLEJAN, BRUNO F., 5428 Linda Rosa, La Jolla, Calif.
DANNER, WILBERT R., Univ. of British Columbia, Vancouver, B. C., Canada
DANTE, JOHN H., 4501 Woodfield Rd., Kensington, Md.
DAPPLES, EDWARD C., Northwestern Univ., Evanston, Ill.
DARROW, GEORGE F., 315 Securities Bldg., Billings, Mont.
DAVIS, BILLY GLEN, 4005 Thomason, Midland, Tex.
*DAVIS, STANLEY N., Stanford Univ., Stanford, Calif.
*DE CARVALHO, G. SOARES, Oliveira de Azemeis, Portugal
DECKER, JACK M., 1707 Elm St., Bakersfield, Calif.
*DE CSERNA, GLORIA ALENCASTER, Apt. 25161, Ciudad Universitaria, Mexico City, Mexico
DELANEY, PATRICK J., Instituto de Ciencias Naturais, Avenida Paulo Gama, Porto Alegre, Brazil, S. A.
DELONG, JACK M., Box 1732, Casper, Wyo.
DENHAM, RICHARD L., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
DENISON, A. RODGER, Amerada Petr. Corp., Box 2040, Tulsa, Okla.
DENNIS, LYMAN C., 5216 S. Columbia Ave., Tulsa, Okla.

DESCHNER, HENRY W., Pakawa Oil Co., Inc., 109 Vaughn Petroleum Bldg., Corpus Christi, Tex.
DEWEES, ALLEN H., Humble Oil & Refg. Co., Carter Div., Box 353, Riverton, Wyo.
DEWIT, REIN, c/o J. C. Sproule & Associates, 1009 Fourth Ave., W., Calgary, Alta., Canada
*DICKINSON, KENDELL A., Univ. of Minnesota, Minneapolis, Minn.
*DICKINSON, WILLIAM R., Stanford Univ., Stanford, Calif.
*DIJKSTRA, SYBREN JAN, Akerstraat 88, Heerlen, Netherlands
DILLINGHAM, HERVIE, JR., Atlantic Refg. Co., Box 1408, Lafayette, La.
*DITSWORTH, GEORGE R., 513 E. Seventh Ave., Albany, Ore.
DIXON, VAL RAY, Dixon Drilling Co., Box 1143, Duncan, Okla.
*DODD, JAMES R., 441 S. Catalina Ave., Pasadena, Calif.
DODGE, HARRY W., JR., Univ. of California, Los Angeles, Calif.
‖DOEGLAS, DIRK JACOBUS, Lab. voor Mineralogie en Geol., Duivendaal 2, Wageningen, Netherlands
*DOLSEN, C. PHILIP, Pennsylvania State Univ., University Park, Pa.
DONALDSON, ALAN C., Univ. of W. Virginia, Morgantown, W. Va.
DONNELLY, ALDEN S., Honolulu Oil Corp., Box 1391, Midland, Tex.
DONOHUE, JOHN J., Aramco, 505 Park Ave. New York, N. Y.
DOROSHENKO, JERRY, 2212 Lyndale La., Billings, Mont.
DOTT, ROBERT H., JR., Univ. of Wisconsin, Madison, Wis.
DRAKE, LARSEN Y., Ohio Oil Co., Enterprise Bldg., Tulsa, Okla.
DRAKE, ROBERT T., 2601 Kemp Blvd., Wichita Falls, Tex.
DRESSER, HUGH W., 509 N. Sixteenth St., E., Riverton, Wyo.
DRIVER, HERSCHEL L., 11 Phillips Rd., Palo Alto, Calif.
DROBNYK, JOHN W., 13 Parkview Dr., Millburn, N. J.
*DROOGER, C. W., Prof. Wentlaan 11, Utrecht, Netherlands
*DROSTE, JOHN B., Univ. of Indiana, Bloomington, Ind.
DUBAR, JULES R., Univ. of Houston, Houston, Tex.
DEFEU, EDWIN L., Standard Oil Co. of Texas, Box 66247, Houston, Tex.
DUNBAR, CAROL O., Yale Univ., New Haven, Conn.
*DUNCAN, JOHN K., U. S. Navy Hydrographic Office, Washington, D. C.
*DUNHAM, KINGSLEY CHARLES, Science Laboratories, Univ. of Durham, Durham, England
DUNHAM, R. J., Shell Devel. Co., Box 481, Houston, Tex.
DUNLAP, JOHN B., JR., Humble Oil & Refg. Co., Box 626, New Orleans, La.
DUNNINGTON, HAROLD V., Iraq Petr. Co., Ltd., 214 Oxford St., London, England
DURHAM, CLARENCE O., JR., Louisiana State Univ., Baton Rouge, La.
DURHAM, J. WYATT, Univ. of California, Berkeley, Calif.
DURKEE, EDWARD F., American Overseas Petr., Ltd., P.K. 52, Vekaletler, Ankara, Turkey
DUSENBURY, A. N., JR., 19 Sherman Ave., Gedney Farms, White Plains, N. Y.

EARGLE, D. HOYE, 2709 Stratford, Rd., Austin, Tex.
EASOM, WILLIAM O., JR., 1108 Welton Way, Inglewood, Calif.
EASTON, WILLIAM H., Univ. of Southern California, Los Angeles, Calif.
*EASTWOOD, WILLIAM C., 429 Vine St., Paso Robles, Calif.
EASTWOOD, WILLIAM P., State Geol. Survey, Grand Forks, N. Dak.
ECHOLS, DOROTHY JUNG, 218 Calverton Rd., Ferguson, Mo.
ECHOLS, JOAN, 1513, Harper St., Lawrence, Kan.
EDGELL, H. STEWART, Geol. Dept., Univ. of Canterbury, Christchurch, New Zealand
EDIE, RALPH W., 300 MacLean Bldg., Calgary, Alta., Canada
EDMUND, R. W., Augustana College, Rock Island, Ill.
EDWARDS, WILLIAM R., 126 S. Eleventh St., Carmi, Ill.
EHLMANN, ARTHUR J., Texas Christian Univ., Fort Worth, Tex.
EICHER, DONALD B., Continental Oil Co., Box 2197, Houston, Tex.
‖EISENACK, A., Geologisch-Palaontologisches Institut, Universitat Tubingen, Tubingen, Germany
EISNER, STEPHEN M., Southwestern Explor. Consultants, Inc., 1619 Republic Bldg., Oklahoma City, Okla.
ELDRIDGE, CHARLES A., Standard Oil Co. of Texas, Box 1660, Midland, Tex.
ELIAS, GREGORY K., 1815 Eastlawn Ave., Durango, Colo.
ELIAS, MAXIM K., Research Inst., Univ. of Oklahoma, Norman, Okla.
ELLIOTT, WAYNE, Peruvian Pacific Petr. Co., Casilla No. 73, Talara, Peru, S.A.
ELLIS, ALBERT D., JR., Pan American Petr. Corp., Box 14085, Houston, Tex.
ELLIS, BROOKS FLEMING, New York Univ., New York, N. Y.
ELLIS, C. HOWARD, JR., Ohio Oil Co., Box 269, Littleton, Colo.
ELLIS, CHARLES W., JR., Continental Oil Co., Box 1267, Ponca City, Okla.
ELLIS, MICHAEL J., U. S. Geol. Survey, Box 1412, Huron, S. Dak.
ELLISON, SAMUEL P., JR., Univ. of Texas, Austin, Tex.
ELLSWORTH, ELMER W., The American Association of Petroleum Geologists, Box 979, Tulsa, Okla.
ELSIK, WILLIAM C., Texas A. & M. College, College Station, Tex.
EMEIS, J. D., Abbenbroekweg 16, The Hague, Netherlands
EMERY, KENNETH O., Univ. of Southern California, Los Angeles, Calif.

*EMILIANI, CESARE, Univ. of Miami, Marine Lab. #1 Rickenbacker Causeway, Virginia Key, Miami, Fla.
EMRICH, GROVER H., State Geol. Survey, Univ. of Illinois, Urbana, Ill.
*ENGEL, BRIAN A., Newcastle University College, Tighes Hill, Newcastle, N.S.W., Australia
*ENLOWS, HAROLD E., Univ. of Tulsa, Tulsa, Okla.
ERICKSON, ROBERT H., 4320 Coronation Dr., Calgary, Alta., Canada
ERWIN, ROBERT B., Texaco Inc., Box 252, New Orleans, La.
*ESKER, GEORGE C., III, 5733 De Giverville, St. Louis, Mo.
ETHINGTON, RAYMOND L., Arizona State College, Tempe, Ariz.
ETTER, JOHN, 107 Melrose Dr., Lafayette, La.
ETTER, KENNETH R., Phillips Petr. Co., Box 491, Midland, Tex.
*EVANS, JAMES R., California Div. of Mines, Rm. 800, 312 W. Fifth St., Los Angeles, Calif.
*EVELAND, HARMON E., Lamar State College of Technology, Beaumont, Tex.
EWBANK, NORMAN W., JR., 1306, N. Big Spring St., Midland, Tex.
EYMANN, JAMES L., Western Gulf Oil Co., Box 4195, Sacramento, Calif.

*FAIRBANK, MRS. NORA GLADWIN, Woods Hole Oceanographic Inst., Woods Hole, Mass.
FAIRBRIDGE, RHODES W., Columbia Univ., New York, N. Y.
FAIRCHILD, WILLIAM W., Standard Oil Co. of Texas, Box 66247, Houston, Tex.
*FAIRLEY, WILLIAM M., Univ. of Notre Dame, Notre Dame, Ind.
FAN, PAUL H., Univ. of Houston, Houston, Tex.
FAN, POW-FOONG, 522 Landfair Ave., Los Angeles, Calif.
FARKAS, STEVEN E., Univ. of New Mexico, Albuquerque, N. Mex.
*FAY, ROBERT O., State Geol. Survey, Univ. of Oklahoma, Norman, Okla.
*FENNER, PETER, Univ. of Illinois, Urbana, Ill.
FERAY, DAN E., Feray Geol. Service, 5415 Palomar Lane, Dallas, Tex.
FERGUSON, GLENN C., Ferguson & Bosworth, Box 4248, Station B, Bakersfield, Calif.
FERGUSON, H. C., 1421 Esperson Bldg., Houston, Tex.
*FERM, JOHN C., Louisiana State Univ., Baton Rouge, La.
*FESSENDEN, FRANKLIN W., College of St. Thomas, St. Paul, Minn.
FISCHER, ALFRED G., Princeton Univ., Princeton, N. J.
FISCHER, DONALD, Texaco Inc., Box 1046, Salt Lake City, Utah
FISK, HAROLD N., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
FLAWN, PETER T., Bureau of Economic Geology, Box 8022, Austin, Tex.
FLORES, GIOVANNI, Mozambique Gulf Oil Co., Caixa Postal 1242, Laurenco Marques, Mozambique
FLOYD, 1/LT. DAVID N., 513 Quartermaster Co., (Direct Supt.), Fort Hood, Tex.
*FLUGEL, HELMUT, Geologisches Institut, Graz Universitat, Graz, Austria
*FOLK, ROBERT L., 1107 Bluebonnet, Austin, Tex.
FOLK, STEWART H., Taylor and Assoc., Inc., 2110 Tennessee Bldg., Houston, Tex.
FONG, GEORGE, Home Oil Co. Ltd., 304 Sixth Ave., W., Calgary, Alta., Canada
FORGOTSON, JAMES M., JR., Pan American Petr. Corp., Box 591, Tulsa, Okla.
FORMAN, MCLAIN J., 424 Whitney Bldg., New Orleans, La.
FORREST, LESH C., 2417 Chester La., Bakersfield, Calif.
*FORTI, AUGUSTO, Petroli dell'Isola, Via del Giardino 3, Palermo, Italy
FOSTER, NORMAN H., Stauffer Pl., Bldg. 21, Apt. 12, Lawrence, Kan.
FOWLER, GERALD A., Univ. of Southern California, University Park, Los Angeles, Calif.
FRASER, DONALD J., Sohio Petr. Co., 309 Eighth Ave. W., Calgary, Alta., Canada
FRAUTSCHY, JEFFERY DEAN, 2625 Ellentown Rd., La Jolla, Calif.
FRAZIER, DAVID E., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
FREDERICKSON, EDWARD A., Univ. of Oklahoma, Norman, Okla.
*FREEMAN, VAL L., U. S. Geol. Survey, Federal Center, Denver, Colo.
FRENZEL, HUGH N., 1118 Mogford St., Midland, Tex.
FRIDDLE, ANNABELLE RICHARDSON, 782 Grove St., Abilene, Tex.
FRIEDMAN, GERALD M., Pan American Petr. Corp., Box 591, Tulsa, Okla.
FRITZ, EDWARD B., Tidewater Oil Co., Box 3936, Karachi, Pakistan
FRITZ, JOSEPH F., Box 2007, Choctaw Sta., Laurel, Miss.
FRIZZELL, DON L., 6 Rolla Gardens, Rolla, Mo.
FROST, JACK, Frost Oil Co., 2106 Tower Petr. Bldg., Dallas, Tex.
*FRUZAN, FARAMARZ, Missouri School of Mines, Rolla, Mo.
FRYE, JOHN C., State Geol. Survey, Univ. of Illinois, Urbana, Ill.
*FUCHTBAUER, HANS, Geologisches Labor., Gewerkschaft Elwerath, Hindenburgstr. 28, Hannover, Germany
*FUJIMOTO, HARUYOSHI, Dept. of Geol., Faculty of Education, Yamagata Univ., Yamagata, Japan
FULMER, CHARLES V., 2366 Eastlake Ave., Rm. 419, Seattle, Wash.
FULREADER, RUFUS E., JR., Shell Oil Co., 1200 First Natl. Bank Bldg., Oklahoma City, Okla.
FURNISH, WILLIAM M., State Univ. Iowa, Iowa City, Iowa
*FURRER, MAX A., California Research Corp., Box 446, La Habra, Calif.

*GALLITELLI, E. MONTANARO, Instituto di Geologia, Universita, Modena, Italy
†GALLOWAY, J. J., Indiana Univ., Bloomington, Ind.
GARDINER, MONTELL L., Humble Oil & Refg. Co., Carter Div., 740 Keeler Bldg., Grand Rapids, Mich.

GARMON, GEORGE T., Sun Oil Co., Box 1270, McAllen, Tex.
GARRETT, J. B., JR., Pan American Petr. Corp., Box 14085, Houston, Tex.
GARRISON, LOUIS E., Lion Oil Co., Box 2049, Casper, Wyo.
*GARRISON, LOWELL E., Western Gulf Oil Co., Box 4195, Sacramento, Calif.
GASTIL, RUSSELL GORDON, San Diego State College, San Diego, Calif.
GATES, GARY R., Indiana Geol. Survey, Indiana Univ. Campus, Bloomington, Ind.
*GAUDETTE, HENRI E., Univ. of Illinois, Urbana, Ill.
GAUGER, DAVID J., 4536 Palmetto St., Bellaire, Tex.
*GAYMAN, WENDELL, Scripps Institution of Oceanography, La Jolla, Calif.
GEALY, WILLIAM J., 503 Thompson Dr., Richardson, Tex.
GEDNETZ, DONALD, Skelly Oil Co., Box 1835, Shreveport, La.
GEES, RUDOLF A., Union Oil Co. of California, Res. Center, Brea, Calif.
*GEHRIG, JOHN L., Chevron Oil Co., Box 448, El Campo, Tex.
GERE, WILLARD C., U. S. Geol. Survey, 457 Federal Bldg., Salt Lake City, Utah
GERLACH, GEORGE S., 1501 E. Swan Circle, Brentwood, Mo.
*GERRARD, TOM A., Univ. of Arizona, Tucson, Ariz.
GIBSON, GEORGE R., 505 Midland Natl. Bank Bldg., Midland, Tex.
GIBSON, JOHN O., San Antonio College, San Antonio, Tex.
GIBSON, LEE B., Univ. of Oklahoma, Norman, Okla.
GIBSON, WILLIAM C., Shell Oil Co., 1700 Broadway, Denver, Colo.
GILBERT, CHARLES M., Univ. of California, Berkeley, Calif.
*GILL, H. E., 126 Andover Rd., Fairless Hills, Pa.
GILLULY, JAMES, U. S. Geol. Survey, Federal Center, Denver, Colo.
*GILMOUR, ERNEST H., 10242 Western, Downey, Calif.
GIMBREDE, LOUIS A., Southwestern Louisiana Inst., Lafayette, La.
GINSBURG, ROBERT N., Shell Devel. Co., 4029 Ponce de Leon Blvd., Coral Gables, Fla.
*GLAESSNER, MARTIN FRITZ, Univ. of Adelaide, Adelaide, South Australia
GLEZEN, WILLIAM H., 6114 Verona Rd., Verona, Pa.
GLUSKOTER, HAROLD J., Univ. of California, Berkeley, Calif.
GODBOLD, PHILIP ROY, JR., 319 W. Park Ave., Tallahassee, Fla.
GOLDICH, SAMUEL S., U. S. Geol. Survey, Washington, D. C.
*GOLDMAN, MARCUS I., 825 New Hampshire Ave., N.W., Washington, D. C.
GOLDSTEIN, AUGUST, JR., Bell Oil & Gas Co., Natl. Bank of Tulsa Bldg., Tulsa, Okla.
GOLLNICK, ROBERT I., c/o Ralph E. Davis Associates, 1216 Niels Esperson Bldg., Houston, Tex.
*GOMEZ, JOSE ROYO Y, Apt. 4585, Caracas, Venezuela, S. A.
GOOCH, DEE D., Box 2052, Lafayette, La.
GOODELL, HORACE GRANT, Florida State Univ., Tallahassee, Fla.
GOODRICH, PAUL K., 1334 Esperson Bldg., Houston, Tex.
GORDON, GEORGE E., Atlantic Refining Co., Box 1346, Houston, Tex.
GORDON, MACKENZIE, JR., U. S. Geol. Survey, Washington, D. C.
GORRELL, H. A., c/o J. C. Sproule & Assoc., 901 Eighth Ave., W., Calgary, Alta., Canada
GORSLINE, DONN S., Oceanographic Inst., Florida State Univ., Tallahassee, Fla.
GOSSETT, CHARLES J., Florida State Univ., Tallahassee, Fla.
GOULD, HOWARD R., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
*GOWDA, S. SAMBE, University of Malaya, Kuala Lumpur, Malaya
*GRADY, JOHN R., 490 Maylin, Pasadena, Calif.
GRAHAM, JOSEPH J., Stanford Univ., Stanford, Calif.
GRANT, DRANE FONES, La Pryor, Tex.
GRANT, RICHARD E., Smithsonian Institution, U. S. Natl. Museum, Washington, D. C.
GRANT, U. S., IV, Univ. of California, Los Angeles, Calif.
GRASSO, VOLKER C., 911 Cravens Ave., San Antonio, Tex.
*GRAVENOR, CONRAD P., Research Council of Alberta, Edmonton, Alta., Canada
GRAY, FRANK F., Western Natural Gas Co., Inc., 213 Royalite Bldg., Calgary, Alta., Canada
GRAY, HENRY H., State Geol. Survey, Univ. of Indiana, Bloomington, Ind.
*GREEN, EDWARD J., 305 Memorial Dr., Cambridge, Mass.
GREEN, KEITH E., Shell Oil Co., 1008 W. Sixth St., Los Angeles, Calif.
*GREENBERG, SEYMOUR S., State Geol. Survey, Univ. of Indiana, Bloomington, Ind.
GREENE, FRANK C., Forest Haven Apts., 2838 Forest Ave., Kansas City, Mo.
*GREENMAN, NORMAN, Shell Oil Co., Box 691, Ventura, Calif.
*GREENSMITH, JOHN T., Geol. Dept., Queen Mary College, London, England
GREGORY, J. N., Box 243, San Angelo, Tex.
GRIFFIN, DAVID L., Petroleum & Natural Gas Br., Dept. of Mines, Douglas Bldg., Victoria, B. C., Canada
GRIFFIN, GEORGE M., Shell Devel. Co., Box 481, Houston, Tex.
GRIFFITHS, J. C., Pennsylvania State Univ., University Park, Pa.
GRIGSBY, R. B., Pan American Petr. Corp., 3955 Bellaire Dr., S., Fort Worth, Tex.
GRILEY, H. L., Box 45, 246 Shenandoah Sta., Miami, Fla.
GRIM, RALPH E., State Geol. Survey, Univ. of Illinois, Urbana, Ill.
GRIMM, KENNETH E., Univ. of Idaho, Moscow, Ida.
*GRIP, ERLAND, Box 420, Boliden, Sweden
GROENEWOLD, B. C., Apache Trailer Town, Durango, Colo.

GROSS, LARRY T., 1265 E. First South, Salt Lake City, Utah
GROSS, MEREDITH GRANT, JR., 1163 Steuben St., Pasadena, Calif.
GRUBAUGH, PHILIP L., U. S. Army Corps of Engineers, Portland, Ore.
GUBER, ALBERT L., Univ. of Illinois, Urbana, Ill.
*GULLENTOPS, FRANK B., Vermeylenstraat 5, Louvain, Belgium
GUSSOW, WILLIAM C., Union Oil Co. of California, 709 Eighth Ave., W., Calgary, Alta., Canada
GUTENTAG, EDWIN D., U. S. Geol. Survey, 310 N. Ninth St., Garden City, Kan.
GUTIERREZ, FERNANDO I., Univ. of the Philippines, Quezon City, Philippines
GUTSCHICK, RAYMOND C., Univ. of Notre Dame, Notre Dame, Ind.
GUZMAN, EDUARDO J., Santa Anita 260, Lomas Hipodromo, Mexico City, Mexico
GWINN, VINTON E., Mobil Oil Co., 250 Mt. Lebanon Blvd., Pittsburgh, Pa.

*HACK, JOHN T., U. S. Geol. Survey, Washington, D. C.
HADLEY, WADE H., JR., Mene Grande Oil Co., Apt. 709, Caracas, Venezuela, S. A.
HAERTLEIN, JAMES A., 6705 Bob-O-Links Dr., Dallas, Tex.
*HAGN, HERBERT, Mettinghstr. 4/1 m, Munich, Germany
HALBOUTY, M. T., The Michel T. Halbouty Bldg., 5111 Westheimer Rd., Houston, Tex.
*HALIM, ABDALLA ABDEL, 16 El-Sahaba St., Before the Shooting Club, Dokki, Cairo, Egypt
HALL, MARY CATHERINE, 1400-B W. Lynn, Austin, Tex.
HALL, W. ELLIS, Atlantic Refg. Co., Box 1610, Midland, Tex.
*HALLER, C. REGIS, Oasis Oil Co. of Libya, Box 317, Tripoli, Libya
HALLGARTH, WALTER E., U. S. Geol. Survey, Federal Center, Denver, Colo.
HALLSTEIN, WILLIAM W., Esso Exploration Guinea, Box 39, Bissau, Portuguese Guinea, West Africa
HALSTED, MORRIS E., Amerada Petr. Corp., 1811 Esperson Bldg., Houston, Tex.
HAM, WILLIAM E., State Geol. Survey, Univ. of Oklahoma, Norman, Okla.
HAMBLIN, RALPH H., Box 384, Olney, Ill.
HAMBLIN, WILLIAM K., Univ. of Kansas, Lawrence, Kan.
HAMILTON, EDWIN LEE, U. S. Navy Electronics Lab., San Diego, Calif.
*HAMLIN, WILLIAM H., 3221 Market St., Seattle, Wash.
*HANCOCK, J. M., University of London, King's College, Strand, London, England
HANNA, G. DALLAS, California Academy of Sciences, San Francisco, Calif.
†HANNA, MARCUS A., 3328 Charleston, Houston, Tex.
*HANSEN, KAJ, Geographical Laboratory, Univ. of Copenhagen, Kejsergade 2, Copenhagen, Denmark
HANSEN, PETER ALLEN, 4822 Forty-fifth, S.W., Seattle, Wash.
*HANSMAN, ROBERT H., Univ. of Cincinnati, Cincinnati, Ohio
HANSON, ALVIN M., 2203 Woody Dr., Billings, Mont.
HANSON, BERNOLD M., c/o James K. Anderson, 110 N. Big Spring, Midland, Tex.
*HANZAWA, SHOSHIRO, Inst. of Geol. & Pal., Tohoku Univ., Sendai, Japan
HARBAUGH, JOHN W., Stanford Univ., Stanford, Calif.
HARDIN, GEORGE C., JR., 114 Maple Valley Rd., Houston, Tex.
HARGES, MARVIN E., Gulf Oil Corp., Box 1150, Midland, Tex.
HARLTON, BRUCE H., Amerada Petr. Corp., Box 2040, Tulsa, Okla.
HARRINGTON, GEORGE L., Stanford Univ., Stanford, Calif.
HARRIS, J. RICHARD, c/o Ralph E. Davis Associates, 1216 Neils Esperson Bldg., Houston, Tex.
HARRIS, REGINALD W., Univ. of Oklahoma, Norman, Okla.
HARRIS, STEVEN H., Box 5, Bismarck, N. Dak.
*HARRISON, W., College of William & Mary, Box 6173, Norfolk, Va.
HARWELL, GEORGE M., JR., Shell Devel. Co., Box 481, Houston, Tex.
‖HATAI, KOTORA, Institute of Geology and Paleontology, Faculty of Science, Tohoku Univ., Sendai, Japan
*HATHAWAY, JOHN C., U. S. Geol. Survey, Federal Center, Denver, Colo.
HATTIN, DONALD E., Indiana Univ., Bloomington, Ind.
HAWKINS, GLENN D., 909 First Natl. Bank Bldg., Tulsa, Okla.
HAWKINS, HAROLD H., U. S. Geol. Survey, Washington, D. C.
*HAWLEY, JOHN WILLIAM, Univ. of Illinois, Urbana, Ill.
HAY, RICHARD L., Univ. of California, Berkeley, Calif.
HAY, WILLIAM W., Univ. of Illinois, Urbana, Ill.
*HAYES, JOHN B., State Univ. of Iowa, Iowa City, Iowa
HAYES, JOHN R., Colorado School of Mines, Golden, Colo.
HAYES, PHILIP T., U. S. Geol. Survey, Federal Center, Denver, Colo.
HAZEL, JOSEPH E., Louisiana State Univ., Baton Rouge, La.
HAZZARD, JOHN C., Union Oil Co. of California, Box 7600, Los Angeles, Calif.
HAZZARD, ROY T., Box 205, Rocksprings, Tex.
HEACOCK, ROBERT L., Shell Oil Co., Box 720, Casper, Wyo.
HEALD, MILTON T., West Virginia Univ., Morgantown, W. Va.
*HECHT, RICHARD J., U. S. Navy Underwater Sound Lab., Ft. Trumbull, New London, Conn.
HEDBERG, HOLLIS D., Princeton Univ., Princeton, N. J.
HEEZEN, BRUCE C., Lamont Geological Observatory, Palisades, N. Y.
HEIMBERG, GEORGE, Sun Oil Co., Box 2880, Dallas, Tex.

HEMER, DARWIN OTTO, Aramco, Box 1371, Dhahran, Saudi Arabia
HENBEST, LLOYD G., U. S. Geol. Survey, 338 U. S. Natl. Museum, Washington, D. C.
HENDERSON, E. J., Box 6675, Jackson, Miss.
HENDRICKS, LEO, Texas Christian Univ., Fort Worth, Tex.
HENDRIX, W. E., Standard Oil Co. of California, Box 2437, Los Angeles, Calif.
HENTON, JOHN M., JR., The California Co., 800 The California Co. Bldg., New Orleans, La.
*HERRING, LOIS SCHULZ, 607 Barry Pl., Altadena, Calif.
HERSHEY, ALAN R., Shell Oil Co., 1008 W. Sixth St., Los Angeles, Calif.
*HESS, HARRY H., Princeton Univ., Princeton, N. J.
HESSLAND, IVAR, Geol. Dept., Stockholms Hogskola, Stockholm, Sweden
*HESSLER, ROBERT R., Box 223, Woods Hole, Mass.
HEWITT, CHARLES H., Ohio Oil Co., Box 269, Littleton, Colo.
HEYMAN, LOUIS, Continental Oil Co., Box 795, Oklahoma City, Okla.
HICKERNELL, ROBERT L., Richfield Oil Corp., Box 147, Bakersfield, Calif.
*HIGAZY, RIAD A., Geological Survey of Egypt, Dawawin Post Office, Cairo, Egypt
HIGGINS, JAMES W., California Research Corp., 200 Bush St., San Francisco, Calif.
HIGGS, WILLIAM R., Louisiana Polytechnic Inst., Box 338, Ruston, La.
HILL, JOHN D., Univ. of Colorado, Boulder, Colo.
HILSEWECK, WILLIAM J., 3709 Colgate, Ave., Dallas, Tex.
HINCHEY, NORMAN S., Washington Univ., St.. Louis, Mo.
HITT, JACK L., Superior Oil Co., Midland, Tex.
HIXON, S. B., 917 E. Huron, Ann Arbor, Mich.
HIXSON, RAY M., JR., Pan American Petr. Corp., Box 432, Liberal, Kan.
HOBBS, LESLIE A., Standard Oil Co. of Texas, Box 945, Snyder, Tex.
HOCKMAN, JAMES N., Box 68, Salem, Ill.
HODGSON, WALTER D., Shell Devel. Co., Box 481, Houston, Tex.
HOFFMEISTER, WILLIAM S., Jersey Production Research Co., 1133 N. Lewis Ave., Tulsa, Okla.
*HOFKER, JAN, Scheveningse laan 157, The Hague, Netherlands
*HOFMANN, FRANZ, c/o George Fischer Ltd., Schaffhausen, Switzerland
HOLCOMB, CHARLES W., Humble Oil & Refg. Co., Box 1271, Corpus Christi, Tex.
HOLCOMB, LEROY D., Shell Oil Co., Box 148, Farmington, N. Mex.
HOLLAND, DAVID S., Ohio Oil Co., Box 552, Midland, Tex.
HOLLAND, F. D., JR., Univ. of North Dakota, Grand Forks, N. Dak.
HOLLENSHEAD, CHARLES T., El Paso Natural Gas Co., 303 Tribune Bldg., Salt Lake City, Utah
HOLLIDAY, SAMUEL, 411 Piney Point Rd., Houston, Tex.
*HOLLINGSWORTH, J. S., Rifle Mine, Union Carbide Nuclear Co., Rifle, Colo.
HOLLINGSWORTH, R. V., Paleontological Laboratory, Box 51, Midland, Tex.
HOLT, OLIN R., 515 N. First St., Fairchild, Ill.
HOOVER, LINN, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D. C.
HOPKINS, M. E., Univ. of Tulsa, Tulsa, Okla.
HORNADAY, GORDON R., Univ. of California, Berkeley, Calif.
*HORNUNG, GILBERT C., Standard Oil Co. of California, Box 278, Oildale, Calif.
HOROWITZ, ALAN STANLEY, Ohio Oil Co., Box 269, Littleton, Colo.
HOSKINS, CORTEZ W., Jersey Production Research Co., 1133 N. Lewis Ave., Tulsa, Okla.
HOUGH, JACK L., Univ. of Illinois, Urbana, Ill.
†HOWE, HENRY V., Louisiana State Univ., Baton Rouge, La.
*HOWELL, B. F., Princeton Univ., Princeton, N. J.
HOWELL, STEPHEN H., Ohio Oil Co., 3923 Harwich La., Jackson, Mich.
HSU, K. JINGHWA, Shell Devel. Co., Box 481, Houston, Tex.
HUBERT, JOHN F., Univ. of Missouri, Columbia, Mo.
HUFFMAN, GEORGE G., Univ. of Oklahoma, Norman, Okla.
HUGHES, ADEN W., Goudkoff & Hughes, 799 Subway Terminal Bldg., 417 S. Hill St., Los Angeles, Calif.
HUGHES, R. J., JR., Box 215, University, Miss.
HUGHES, RICHARD DAVID, Memorial Univ., St. John's, Newfoundland, Canada
HUGHES, URBAN B., Box 1830, Laurel, Miss.
*HUGI, THEODOR, Dept. of Mineralogy, University, Sahlistr. 6, Berne, Switzerland
HULL, JOSEPH P. D., JR., Kerr-McGee Oil Ind., Inc., Suite 217B, 300 Mt. Lebanon Blvd., Pittsburgh, Pa.
*HULSEY, J. D., 905 S. First St., Apt. 17, Champaign, Ill.
HUME, JAMES D., Tufts Univ., Medford, Mass.
HURLBUT, ELVIN M., JR., Shell Oil Co., Box 2037, Tyler, Tex.
*HUMPHRIES, D. W., Department of Geology, The University, Sheffield, England
HUSAIN, B. R., Shell Oil Co., Box 5011, Karachi, Pakistan
HUTCHESON, R. B., 2817 Twentieth St., Bakersfield, Calif.

IKINS, W. CLYDE, 9125 Chatsworth, Houston, Tex.
*ILLIES, J. HENNING, Inst. fur Geol. Technische Hochschule Karlsruhe, Kaiserstrasse 12, Karlsruhe, Germany
ILLING, LESLIE V., c/o V. C. Illing & Partners, 23/4 Cromwell Pl., S. Kensington, London, England
IMBRIE, JOHN, Columbia Univ., New York, N. Y.
*INDERBITZEN, ANTON LOUIS, 1943 N. Hoover St., Los Angeles, Calif.
*INGLE, JAMES C., JR., 5711 Harcourt Ave., Los Angeles, Calif.
INGRAM, ROY L., Univ. of North Carolina, Chapel Hill, N. Car.
*INMAN, DOUGLAS L., Scripps Institution of Oceanography, La Jolla, Calif.

IRELAND, HUBERT A., Univ. of Kansas, Lawrence, Kan.
ISBELL, GROVER J., Cameron Oil Co., 1100 Petr. Club Bldg., Oklahoma City, Okla.
ISRAELSKY, MERLE C., U. S. Geol. Survey, 4 Homewood Pl., Menlo Park, Calif.
*ITEN, KEN W. B., Benguet Consolidated Mining Co., Baguio City, Mt. Province, Philippines

JACKA, ALONZO D., Texas Technological College, Lubbock, Tex.
JACOBSEN, LYNN, Standard Oil Co. of Ohio, Midland Bldg., Cleveland, Ohio
*JAMES, GIDEON T., Univ. of California, Berkeley, Calif.
JAMES, JOHN W., American Overseas Petr. (Spain) Ltd., Secretario Artiles 63-2º, (Puerto de la Luz), Las Palmas de Gran Canaria, Canary Islands
JANSEN, GERHARD C. J., Esso Standard (Libya) Inc., Box 385, Tripoli, Libya
*JANSEN, JOHN FREDERICK, Texas A. & M. College, College Station, Tex.
*JARMAN, GARY DAVIS, 211 Church St., Dallas, Ore.
JEFFORDS, RUSSELL M., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
JENNINGS, TED V., Pastotex Petr. Co., 800 Fidelity Natl. Bldg., Oklahoma City, Okla.
JESTES, EDWARD C., Univ. of Hawaii, Honolulu, Hawaii
JETT, KENNETH H., Darrell W. Smith Co., Midland, Tex.
*JOHANSSON, WARREN, Univ. of Massachusetts, Amherst, Mass.
*JOHNSEN, JOHN H., Vassar College, Poughkeepsie, N. Y.
JOHNSON, CHESTER O., Gustavus Adolphus College, St. Peter, Minn.
*JOHNSON, DEAN M., 1002 Emerson St., Pasadena, Calif.
JOHNSON, F. W., Jersey Production Research Co., 1133 N. Lewis Ave., Tulsa, Okla.
JOHNSON, FREDERICK A., JR., Humble Oil & Refg. Co., Box 1600, Midland, Tex.
JOHNSON, J. HARLAN, Colorado School of Mines, Golden, Colo.
JOHNSON, NORMAN LEE, Sinclair Oil & Gas Co., Box 521, Tulsa, Okla.
*JOHNSON, ROBERT B., Purdue Univ., Lafayette, Ind.
*JOHNSON, WENDELL B., 165 Canton Club Circle, Jackson, Miss.
JOHNSON, WILLIAM R., Texaco Inc., Box 1869, Ardmore, Okla.
JOHNSTON, IAN MCKAY, Texaco Inc., Box 1305, Oil Center Sta., Lafayette, La.
*JONES, BRADFORD C., 1850 E. Sycamore St., Rt. 3, Anaheim, Calif.
JONES, DANIEL H., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
JONES, DANIEL J., Univ. of Utah, Salt Lake City, Utah
JONES, DOUGLAS E., Univ. of Alabama, University, Ala.
*JONES, PRESTON D., 18524 S. Gramercy Pl., Torrance, Calif.
JONES, VERNER, 14 McLaren Rd., Darien, Conn.
*JONES, WAYNE PAUL, 3800 Minnesota Ave., Fair Oaks, Calif.
JONS, RICHARD D., c/o Ralph Lowe, Box 832, Midland, Tex.
JULLIAN, Y., Omnirex, 280 Bd. St. Germain, Paris, France
JURIN, NICHOLAS V., Texaco Inc., 3350 Wilshire Blvd., Los Angeles, Calif.

*KAHN, J. STEVEN, Univ. of Rhode Island, Kingston, R. I.
*KANEHARA, KINJI, No. 10-ro-14 Nishikatamachi, Bunkyo-ku, Tokyo, Japan
*KANES, WILLIAM H., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
KANIK, STAN A., Dept. of Northern Affairs & Mineral Resources, Ottawa, Ont., Canada
KARCHER, J. C., 2328 Fidelity Union Tower, Dallas, Tex.
KARGES, HAROLD E., Box 1635, Jackson, Miss.
*KARROW, PAUL F., Ontario Dept. of Mines, Parliament Bldg., Toronto, Ont., Canada
KASKA, HAROLD V., Cia. Guatemala California de Petroleo, Apt. 1307, Guatemala City, Guatemala
KASTLER, NEIL B., Aeronautical Ch. & Info. Center, Second & Arsenal Sts., St. Louis, Mo.
KATE, FREDERICK H., 5801 N.W. Fifty-sixth St., Oklahoma City, Okla.
KAUFFMAN, JAMES S., Sunray Mid-Continent Oil Co., Roswell, N. Mex.
KAUFMANN, G. F., Dogwood Dr., R. D. 1, Box 312, Yorktown Heights, N. Y.
KAY, G. MARSHALL, Columbia Univ., New York, N. Y.
KEENAN, JAMES E., Mobil Oil Co., Box 1652, Casper, Wyo.
KEESLING, STUART A., 86 Hastings Ave., Ventura, Calif.
KELLER, GEORGE H., U. S. Navy Hydrographic Office, Washington, D. C.
KELLER, W. D., Univ. of Missouri, Columbia, Mo.
KELLEY, D. G., Geol. Survey of Canada, 601 Booth St., Ottawa, Ont., Canada
KELLEY, FREDERIC R., 437 Panchita Way, Los Altos, Calif.
KELLOUGH, GENE ROSS, 254 Dillon, Houston, Tex.
KELLUM, LEWIS B., Univ. of Michigan, Ann Arbor, Mich.
KEMP, AUGUSTA HASSLOCK, 411 N. Tackitt, Seymour, Tex.
*KEMPER, EDWIN, c/o Deilmann, Bergbau B.m.b.H., Bentheim 23, Germany
KENNEDY, E. R., JR., Argo Oil Corp., Drawer 432, Midland, Tex.
KERR, S. DUFF, JR., Shell Oil Co., Box 1509, Midland, Tex.
*KERRICK, WALLACE G. L., 7622 S. Yakima, Tacoma, Wash.
KEYSER, JOSEPH E., c/o Gipson & Keyser, Box 446, Midland, Tex.
KEYZER, FRANS GASPARD, Libyan Atlantic Co., Box 885, Tripoli, Libya
*KHAN, M. H., The Burmah Oil Co. (P.T.) Ltd., P.I.D.C. House, Kutchery Rd., Box 4813, Karachi, Pakistan

KIATTA, HOWARD W., Texaco Inc., Box 252, New Orleans, La.
KIDWELL, ALBERT L., Jersey Production Research Co., 1133 N. Lewis, Tulsa, Okla.
KILGORE, JOHN E., 6218 Carew, Houston, Tex.
KING, RALPH H., 1641 Oxford Rd., Lawrence, Kan.
KING, ROBERT EVANS, American Overseas Petr. Co., 485 Lexington Ave., New York, N. Y.
*KING, WILLIAM E., Univ. of Eastern New Mexico, Portales, N. Mex.
KIRBY, LOUIE C., Box 302, Troup, Tex.
KIRSCH, M. I., 13759 Saratoga Vista Ave., Saratoga, Calif.
*KITTLEMAN, LAURENCE R., Box 5126, Univ. Sta., Eugene, Ore.
KJELLESVIG-WAERING, ERIK N., Casilla de Correos 5092, Buenos Aires, Argentina, S.A.
KLEIN, GEORGE DEVRIES, Sinclair Research Lab., Inc., Box 3006, Tulsa, Okla.
KLEINKOPF, M. DEAN, Standard Oil Co. of California, Box 1076, Salt Lake City, Utah
KLEINPELL, ROBERT M., 5959 Margarido Dr., Oakland, Calif.
KNEBEL, GEORGE MOSES, 10 Paddington Rd., Scarsdale, N. Y.
KNIGHT, RAYMOND L., McElroy Ranch Co., 3132 Eighteenth St., Bakersfield, Calif.
KNIKER, HEDWIG T., 761 Baker Ave., Seguin, Tex.
*KOBAYASHI, TEIICHI, Fac. of Science, Univ. of Tokyo, Tokyo, Japan
KOENIG, KARL J., Texas A. & M. College, College Station, Tex.
KOESTER, EDWARD A., 417 C. A. Johnson Bldg., Denver, Colo.
*KOHLS, DONALD W., Rosemount, Minn.
*KOLLMANN, K., Rohoel-Gewinnungs A.G., Schwarzenbergplatz 16, Vienna I., Austria
*KOLPACK, RONALD LLOYD, 1125 W. Rowland Ave., West Covina, Calif.
KONIGSMARK, THEODORE ALBERT, Mobil Oil Co. of Venezuela, Apt. 5373, Caracas, Venezuela, S. A.
*KOPSTEIN, F. P. H. W., Bilderdijklaan 115, Rijswijk (Z.H.), Netherlands
KORNICKER, LOUIS S., Office of Naval Research, 86 E. Randolph St., Chicago, Ill.
*KOSTER, HEINRICH M., Staatl. Forschungsinstitut fur angew. Mineralogie, Kumpfmuhlerstr. 2, Regensburg, Germany
KRAETSCH, R. B., JR., Standard Oil Co. of California, 11 C Camp, Taft, Calif.
KRAFT, JOHN C., Shell Oil Co., Box 880, Calgary, Alta., Canada
KRAUSE, ERWIN K., Shell Oil Co., Box 1861, Corpus Christi, Tex.
KRAYE, ROBERT FRANK, Atlantic Refg. Co., Box 6640, Roswell, N. Mex.
*KRINSLEY, DAVID H., Queens College, Flushing, N. Y.
KRUMBEIN, W. C., Northwestern Univ., Evanston, Ill.
KRUTAK, PAUL R., Louisiana State Univ., Baton Rouge, La.
KRYNINE, PAUL D., Pennsylvania State Univ., University Park, Pa.
‖KUENEN, PH. H., Geologisch Instituut, Melkweg 1, Groningen, Netherlands
KUFFEL, GEORGE C., Shell Oil Co., 2080 Obispo, Long Beach, Calif.
KUGLER, H. G., Natural History Museum, Augustinergasse, Basel, Switzerland
KUMMEL, BERNHARD, Harvard Univ., Cambridge, Mass.
KURIE, ANDREW E., Pure Oil Co., Box 671, Midland, Tex.

LADD, HARRY S., U. S. Geol. Survey, Washington, D. C.
LAGRANGE, JOHN H., Bear Creek Mining Co., Box 524, Mellen, Wis.
LAIMING, BORIS, Texaco Inc., 3350 Wilshire Blvd., Los Angeles, Calif.
LAIRD, ROBERT F., 3350 Ben Lomond Dr., Sacramento, Calif.
LALICKER, CECIL G., 6101 E. Morris, Wichita, Kan.
LAMB, JAMES L., Creole Petr. Corp., Apt. 172, Maracaibo, Estado Zulia, Venezuela, S. A.
LAMBERT, ERNEST H., JR., Ohio Oil Co., 770 Milner Bldg., Jackson, Miss.
LAMKIN, ALFRED W., JR., 2607 Shenandoah Dr., Tyler, Tex.
LANDES, KENNETH K., Univ. of Michigan, Ann Arbor, Mich.
LANG, WALTER B., 3133 Connecticut Ave., N.W., Washington, D. C.
*LANKFORD, ROBERT R., Pan American Petr. Corp., Box 3092, Houston, Tex.
*LARSEN, NORMAN R., 2196 N. Orange Grove Ave., Pomona, Calif.
LATTMAN, LAURENCE, Pennsylvania State Univ., University Park, Pa.
LAUKEL, QUINN C., Sun Oil Co., 503 N. Central Expressway, Richardson, Tex.
LAUTENSCHLAGER, H. K., 3012 Pomona St., Bakersfield, Calif.
LAUTH, R. E., Box 776, Durango, Colo.
LEAVITT, JONATHAN B., 221-B Boxwood Rd., Oceanside, Calif.
LEBLANC, ARTHUR E., Shell Oil Co., Box 1509, Midland, Tex.
LEBLANC, RUFUS J., Shell Oil Co., Box 2099, Houston, Tex.
*LEE, THOMAS DUONNE, Mobil Oil Co., Box 3308, Bellaire, Tex.
*LEES, ALAN, Dept. of Geology, The University, Reading, Berkshire, England
Lehmann, Elroy P., Mobil Oil of Canada (Libyan Branch), Box 690, Tripoli, Libya
LEIBROCK, R. M., Leibrock, Landreth & Campbell, Box 91, Midland, Tex.
LEITH, CARLTON J., 1900 Country Club Dr., Bakersfield, Calif.
*LENNON, RUSSELL B., Shell Oil Co., 1845 Sherman St., Denver, Colo.
*LEONARDI, PIERO, Via Boldini 14, Ferrara, Italy
*LERBEKMO, J. F., Dept. of Geology, University of Alberta, Edmonton, Alta., Canada
LEROY, Duane O., 909 S. Jefferson Davis Pkwy., Rm. 457, New Orleans, La.
LEROY, LESLIE W., Colorado School of Mines, Golden, Colo.
LESPERANCE, P. J., 460 De Lavigerie, Sainte Foye, Quebec, Que., Canada

*LEUTZE, WILLARD P., Texaco Inc., Box 252, New Orleans, La.
LEVIN, HAROLD L., Standard Oil Co. of California, Box 278, Oildale, Calif.
LEVINSON, STUART A., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
†LEVORSEN, A. I., 1525 E. Twenty-seventh St., Tulsa, Okla.
*LEVORSEN, JOHN A., Richfield Oil Corp., Box 147, Bakersfield, Calif.
LEWIS, JOHN H., Colorado College, Colorado Springs, Colo.
LEWIS, PRENTISS D., JR., 3217 Alabama Ave., Shreveport, La.
LIBBY, WILLARD G., Univ. of Washington, Seattle, Wash.
*LIEBE, RICHARD M., State Univ. of Iowa, Iowa City, Iowa
LIGHT, MITCHELL A., 15414 E. Midwest Dr., Whittier, Calif.
LINDBLOM, ROBERT, Standard Oil Co. of California, Box 278, Oildale, Calif.
*LING, HSIN-YI, Pan American Petr. Corp., Box 591, Tulsa, Okla.
LIPSHULTZ, FRANKLIN W., JR., Ohio Oil Co., Box 958, Liberal, Kan.
LITTLE, CURTIS J., 2929 Monte Vista, N.E., Albuquerque, N. Mex.
*LOBUE, JOSEPH F., Department of Water Resources, 1100 S. Grand, Los Angeles, Calif.
LOEBLICH, ALFRED R., JR., California Research Corp., Box 446, La Habra, Calif.
LOGAN, JOHN, USOM, Port-au-Prince, Department of State, Washington, D. C.
LOHMAN, KENNETH E., U. S. Geol. Survey, Washington, D. C.
*LOKKE, DONALD H., Pan American Petr. Corp., Box 1410, Fort Worth, Tex.
LOMBARD, AUGUSTIN E., Laboratoire de Geologie de l'Universite, Quai de l'Ecole de Medecine, Geneva, Switzerland
LONG, ROBERT E., 4344 Linden Ave., Long Beach, Calif.
LOOMIS, FREDERIC B.,Clark Oil & Refg. Corp., 2117 Tower Bldg., 1700 Broadway, Denver, Colo.
*LOUGHNAN, F. C., Geology Dept., University of New South Wales, Sydney, Australia
*LOUPEKINE, I. S., Geology Dept., Royal College, Private Bag, Nairobi, Kenya
*LOVEJOY, BILL P., Shell Oil Co., Box 1509, Midland, Tex.
LOVEJOY, DONALD W., Rollins College, Winter Park, Fla.
LOWENSTAM, HEINZ A., California Inst. of Technology, Pasadena, Calif.
LOWNES, RICHARD E., 651 S. Hudson Ave., Pasadena, Calif.
LOZO, FRANK E., JR., Shell Devel. Co., Box 481, Houston, Tex.
LUCAS, ELMER LAWRENCE, 219 W. Eufaula St., Norman, Okla.
LUCKETT, JOSEPH W., JR., The Pure Oil Co., Box 671, Midland, Tex.
*LUDWICK, JOHN C., Gulf Res. & Devel. Co., Box 2038, Pittsburgh, Pa.
LUGN, ALVIN L., 1601 S. Twentieth St., Lincoln, Neb.
*LUKANUSKI, JAMES N., 828 N. Twelfth, Corvallis, Ore.
LUMSDEN, WILLIAM W., JR., 723 N. Philadelphia St., Anaheim, Calif.
*LUND, ERNEST H., Univ. of Oregon, Eugene, Ore.
*LUNDIN, ROBERT FOLKE, 1107 W. Green St., Urbana, Ill.
LUSTIG, LAWRENCE K., 25 Bromfield St., Watertown, Mass.
LYNCH, SHIRLEY A., Texas A. & M. College, College Station, Tex.
*LYNTS, GEORGE WILLARD, Univ. of Wisconsin, Madison, Wis.
LYON, CRAIG A., Standard Oil Co. of California, Box 7-839, Anchorage, Alaska

MABY, ROBERT L., JR., Arabian American Oil Co., Abqaiq, Saudi Arabia
*MACFADYEN, W. A., Hope's Grove, Tenterden, Kent, England
MACFARQUHAR, WILLIAM K., Sinclair Somal Corp., Box 16, Mogadiscio, Somalia, Africa
MACKENZIE, DAVID B., Ohio Oil Co., Box 269, Littleton, Colo.
*MACLACHLAN, MARJORIE E., U. S. Geol. Survey, Federal Center, Denver, Colo.
MACNAUGHTON, LEWIS W., 4636 Meadowood Rd., Dallas, Tex.
MAGEE, JOHN J., Mobil Oil Francaise, 54 Rue de Londres, Paris, France
*MAGNE, JEAN, c/o Esso Standard, 210 Cours Victor Hugo, Begles (Gironde), France
*MAHAPATRA, M. N., Dept. of Atomic Energy, c/o U. K. Patnaik, Church Lane, Balasore, Orissa, India
*MAJOR, C. FRED, JR., Shell Devel. Co., Box 481, Houston, Tex.
*MAKIYAMA, JIRO, Kyoto Univ., Kyoto, Japan
MALICOAT, ARTHUR F., Gulf Oil Corp., Box 1590, New Orleans, La.
MALLORY, V. STANDISH, Univ. of Washington, Seattle, Wash.
*MALONEY, NEIL J., 535 S. Fourteenth, Corvallis, Ore.
MAMET, BERNARD L., 22 Av. du Pere Damien, Brussels, Belgium
MANGER, G. E., U. S. Geol. Survey, Washington, D. C.
MANKIN, CHARLES J., Univ. of Oklahoma, Norman, Okla.
*MANLEY, FREDERICK H., Jr., Univ. of Oklahoma, Norman, Okla.
MANN, JOHN F., JR., 945 Reposado Dr., La Habra, Calif.
MARCHER, MELVIN V., 537 Inwood Dr., Nashville, Tenn.
MARCHETTI, MARCO P., Via Giuseppe Antonio Guattani 14, Rome, Italy
MARIANOS, ANDREW W., Humble Oil & Refg. Co., Box 1196, Newhall, Calif.
MARKS, EDWARD, Union Oil Co. of California, 800 Prudential Bldg., Houston, Tex.
MARKS, JAY GLENN, Humble Oil & Refg. Co., Carter Div., Box 120, Denver, Colo.
*MARLOWE, JAMES I., New Jersey Zinc Co., Box 110, Salem, Mo.
MARRALL, GERALD E., Union Oil Co. of California, Compton, Calif.

MARTENS, JAMES H. C., Rutgers Univ., New Brunswick, N. J.
MARTIN, BRUCE D., Univ. of Southern California, Los Angeles, Calif.
MARTIN, GENE B., Gulf Oil Corp., Box 1590, New Orleans, La.
MARTIN, JAMES L., JR., Sinclair Oil & Gas Co., Box 521, Tulsa, Okla.
MARTIN, LEWIS, American Overseas Petr., Ltd., Box 693, Tripoli, Libya
MARTIN, LOIS T., 1912 Eye St., Sacramento, Calif.
MARTIN, WAYNE, Miami Univ., Oxford, Ohio
MARTINEZ, JOSEPH D., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
MARTYN, PHIL F., 5450 Tilbury Dr., Houston, Tex.
MASSON, PETER H., Jersey Production Research Co., 1133 N. Lewis, Tulsa, Okla.
MATEER, WARREN D., Rt. 1, Box 7, Golden, Colo.
*MATHER, KATHARINE, Waterways Experiment Sta., Drawer, 2131, Jackson, Miss.
*MATHUR, S. M., Geological Survey of India, 27 Chowringhee, Calcutta, India
MATTHEWS, WILLIAM H., III, Lamar State College of Technology, Beaumont, Tex.
MATTOX, RICHARD B., Texas Technological College, Lubbock, Tex.
*MAURER, DONALD L., 1414 Arthur Ave., Chicago, Ill.
MAYNC, WOLF, Steinhubeliweg 6, Muri, Berne, Switzerland
MAZZOLA, JOSEPH R., Texas Gulf Producing Co., 1509 Mile High Center, Denver, Colo.
*MCBRIDE, EARLE F., Univ. of Texas, Austin, Tex.
*MCBRIDE, MARY WOOD, c/o D. R. McCord, 504 Meadows Bldg., Dallas, Tex.
MCCALLUM, JOHN S., Shell Devel. Co., Box 481, Houston, Tex.
*MCCAMMON, RICHARD B., 104 Fourth Ave., S., Grand Forks, N. Dak.
*MCCANN, NOEL F., Texaco Trinidad Inc., Guayaguayare, Trinidad, W. I.
MCCARTER, JOHN H., JR., Northeast Louisiana State College, Monroe, La.
MCCLURE, HAROLD A., Aramco, Box 273, Abqaiq, Saudi Arabia
MCCONVILLE, ROBERT J., Signal Oil & Gas Co., 640 Seventh Ave., S.W., Calgary, Alta., Canada
MCCROSSSAN, R. G., Imperial Oil, Ltd., 300 Ninth Ave., W., Calgary, Alta., Canada
MCCUBBIN, DONALD G., Ohio Oil Co., Box 269, Littleton, Colo.
MCDOWELL, JOHN P., Tulane Univ., New Orleans, La.
MCEWEN, MICHAEL C., Rice Univ., Houston, Tex.
MCFARLAN, EDWARD, JR., Humble Oil & Refg. Co., Box 626, New Orleans, La.
MCGEE, DEAN A., Kerr-McGee Bldg., Oklahoma City, Okla.
MCGLASSON, ROBERT, Texaco Inc., 3350 Wilshire Blvd., Los Angeles, Calif.
MCGREGOR, DUNCAN J., State Geol. Survey, Indiana Univ., Bloomington, Ind.
MCGUGAN, ALAN, 2515 Fourteenth-A St., S.W., Calgary, Alta., Canada
*MCINTYRE, DONALD D., Union Carbide Nuclear Co., Box 324, Tuxedo, N. Y.
*MCINTYRE, JOHN B., 1010 Paul Dr., Rockville, Md.
MCKEE, EDWIN D., U. S. Geol. Survey, Federal Center, Denver, Colo.
MCLAREN, DIGBY J., Geol. Survey of Canada, Ottawa, Ont., Canada
MCLAUGHLIN, DONALD H., JR., Boliva California Petr. Co., Casilla 653, Cochabamba, Boliva, S.A.
MCLEAN, JAMES D., JR., 4 Summit Pl., Belle Haven, Alexandria, Va.
MCMANUS, DEAN A., Univ. of Washington, Seattle, Wash.
MCMASTER, R. L., Narragansett Marine Lab., Univ. of Rhode Island, Kingston, R. I.
MCNULTY, C. L., JR., Arlington State College, Arlington, Tex.
*MEADE, ROBERT H., JR., U. S. Geol. Survey, 4 Homewood Pl., Menlo Park, Calif.
*MEANS, JOHN A., Sun Oil Co., Box 2880, Dallas, Tex.
*MELENDEZ, BERMUDO, Museo de Ciencias Naturales, Paseo de la Castellana 84, Madrid, Spain
MELHORN, WILTON N., Purdue Univ., Lafayette, Ind.
MELLEN, FREDERIC F., Box 2584, Jackson, Miss.
*MELLIS, OTTO, Mineralogiska Inst., Drottninggatan 116, Stockholm, Sweden
MENARD, HENRY W., JR., Scripps Institution of Oceanography, La Jolla, Calif.
MENCHER, ELY, Massachusetts Inst. of Technology, Cambridge, Mass.
MENELEY, ROBERT A., Imperial Oil Co., Ltd., Dawson Creek, B. C., Canada
*MERLA, GIOVANNI, Instituto di Geol., Via Lamarmora 4, Florence, Italy
MERRIAM, DANIEL F., State Geol. Survey, Univ. of Kansas, Lawrence, Kan.
MERRILL, WILLIAM M., Syracuse Univ., Syracuse, N. Y.
MESSINA, ANGELINA R., American Museum of Natural History, Seventy-ninth St. & Central Park W., New York, N. Y.
METZ, HAROLD L., Princeton Univ., Princeton, N. J.
METZGER, CARL J., 10901 S. Prospect Ave., Chicago, Ill.
*MEYER, GRANT E., Richfield Oil Corp., 5900 Cherry Ave., Long Beach, Calif.
MEYER, RICHARD F., Box 1287, Roswell, N. Mex.
MEYER, WILLIS G., 1400 Republic Natl. Bank Bldg., Dallas, Tex.
MEYERHOFF, A. A., Chevron Oil Co., 9029 Jefferson Highway, New Orleans, La.
MICHAELIS, ERIC R., Pan American Petr. Corp., 444 Seventh Ave., S.W., Calgary, Alta., Canada
MICHAELSON, LOUIS H., Texas Gulf Producing Co., Box 1764, Midland, Tex.
MICHELIN, JAMES, 1135 W. Huntington Dr., Arcadia, Calif.
MIDDLETON, GERARD V., Dept. of Geology, McMaster Univ., Hamilton, Ont., Canada

MIDDLETON, HERMAN F., Amerada Petr. Corp., 3219 W. Louisiana Ave., Midland, Tex.
*MIDDOUR, E. S., South Texas Stratigraphic Service, 313, Wilson Bldg., Corpus Christi, Tex.
*MIELENZ, RICHARD C., Master Builders Co., 2490 Lee Blvd., Cleveland, Ohio
MIHALSKY, ROBERT, Amerada Petr. Corp., Box 1009, Williston, N. Dak.
*MILLER, A. K., State Univ. Iowa, Iowa City, Iowa
MILLER, DANIEL N., JR., Lion Oil Co., Casper, Wyo.
MILLER, ROBERT R., Northern Natural Gas Co., 2223 Dodge St., Omaha, Neb.
MILLOT, GEORGES, Laboratory of Geology, University of Strasbourg, Strasbourg, France
MILLS, LLOYD C., Box 1515, Midland, Tex.
*MIRIGLIANO, GIUSEPPE, Via E. de Marinis 1, Napoli, Italy
*MIRSKY, ARTHUR, Box 3085, Columbus, Ohio
MOBERLY, RALPH M., JR., Univ. of Hawaii, Honolulu, Hawaii
*MONAGHAN, PATRICK H., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
Montgomery, J. C., Harrison Oil Co., Gulf Bldg., Houston, Tex.
MONTGOMERY, JAMES H., Youngblood & Youngblood, 1212 Adolphus Tower, Dallas, Tex.
MONTGOMERY, PORTER A., JR., Montgomery's Stratigraphic Service, 1725 Milam Bldg., San Antonio, Tex.
MOODY, CLARENCE L., 23 W. Oak Dr., Houston, Tex.
MOORE, DAVID G., 9440 La Jolla Shores Dr., La Jolla, Calif.
MOORE, DEREK, Dept. of the Geological Survey, Sekondi, Ghana
MOORE, FRED E., Colorado School of Mines, Golden, Colo.
MOORE, JAMES ROBERT, III, Texaco Inc., Box 425, Bellaire, Tex.
MOORE, JOHN E., U. S. Geol. Survey, Federal Center, Denver, Colo.
MOORE, PETER F., Bataafse International Petroleum Mij., Carel van Bylandtlaan 30, The Hague, Netherlands
†MOORE, RAYMOND C., State Geol. Survey, Univ. of Kansas, Lawrence, Kan.
*MOORE, WALTER L., 15 State St., Grand Forks, N. Dak.
MOREMAN, WALTER L., Mobil Oil Co., 110 Sixteenth St., Denver, Colo.
MOREY, PHILIP S., Bureau of Economic Geology, Box 8022, Austin, Tex.
MORGAN, AYLMER LEE, III, F. A. Gallery, Inc., 608 Natl. Bank of Commerce Bldg., New Orleans, La.
MORGAN, JAMES L., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
MORGRIDGE, DEAN L., Humble Oil & Refg. Co., Box 7-248, Anchorage, Alaska
*MORRIS, CHARLES B., 7003 Yates Ave., Austin, Tex.
MORRIS, ROBERT W., Arabian American Oil Co., Box 2576, Dhahran, Saudi Arabia
MORRISON, T. E., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
*MOSS, JOHN HALL, 1034 Lampeter Rd., Lancaster, Pa.
MOUNTJOY, ERIC W., Geological Survey of Canada, Ottawa, Ont., Canada
*MOYLE, RICHARD W., 406 Stadium Park, Iowa City, Iowa
*MUELLER, BRUCE E., 6733 Forest Hills Rd., Rockford, Ill.
MUENZINGER, JOHN W., Continental Oil Co., 1025 Hamilton Bldg., Wichita Falls, Tex.
MUERY, WARREN E., Superior Oil Co. of Venezuela, Apt. 168, Maracaibo, Venezuela, S.A.
MUIR, J. LAWRENCE, 1609 W. Main, Enid, Okla.
MULVANE, SONJA BLEGEN, 2254-D N. Beachwood Dr., Hollywood, Calif.
MUNSEY, GORDON C., Jr., Atlantic Refg. Co., Box 1408, O. C. S., Lafayette, La.
MUNYAN, ARTHUR C., 267 E. High St., Lexington, Ky.
*MURATA, SHIGEO, Kyushu Institute of Technology, Tobata City, Japan
*MURPHY, PHILIP J., 303½ First St., Kirkland, Wash.
MURRAY, GROVER E., Louisiana State Univ., Baton Rouge, La.
MURRAY, HAYDN H., Georgia Kaolin Co., 433 N. Broad St., Elizabeth, N. J.
MURRAY, RAYMOND C., Shell Devel. Co., Box 481, Houston, Tex.
MYERS, DONALD A., U. S. Geol. Survey, Federal Center, Denver, Colo.

NADEAU, BETTY KELLETT, Socony Mobil Oil Co., P. K. 170, Mersin, Turkey
*NAFF, JOHN DAVIS, Oklahoma State Univ., Stillwater, Okla.
NANZ, ROBERT H., JR., Shell Devel. Co., Box 481, Houston, Tex.
NAPOLI, ENRICO F. DI, Via Giuseppe Antonio Guattani 14, Rome, Italy
*NARAIN, KEDAR, Geological Survey of India, Wala Qadar Rd., Lucknow, India
*NARASIMHAN, TYAGARAJAN, Indian School of Mines, Dhanbad, Bihar, India
NATLAND, M. L., Richfield Oil Corp., 555 S. Flower St., Los Angeles, Calif.
NAYUDU, Y. R., Univ. of Washington, Seattle, Wash.
NEEV, DAVID, Bialik St. No. 7, Beit Hakerem, Jerusalem, Israel
*NEGLIA, STEFANO, AGIP Mineraria, S. Donato Milanese, Milano, Italy
NELSON, BRUCE W., Virginia Polytechnic Inst., Blacksburg, Va.
NELSON, HENRY F., Mobil Oil of Canada, Box 690, Tripoli, Libya
NELSON, LLOYD A., Texas Western College, El Paso, Tex.
*NELSON, PAUL HUGH, Western Natural Gas Co., Box 1508, Houston, Tex.
NEUMAN, ROBERT B., U. S. Geol. Survey, Washington, D. C.
NEUSTADT, WALTER, JR., Westheimer-Neustadt, Box 974, Ardmore, Okla.
NEWELL, NORMAN D., American Museum of Natural History, New York, N. Y.
NICHOLERIS, NESTOR, Superior Oil Co., Box 600, Denver, Colo.

*NICHOLS, MAYNARD M., Univ. of California, Los Angeles, Calif.
NICHOLS, PAUL H., Shell Oil Co., Box 2037, Tyler, Tex.
NICKELSEN, RICHARD P., Bucknell Univ., Lewisburg, Pa.
NIENABER, JAMES H., American Overseas Petr., Ltd., Box 693, Tripoli, Libya
*NIEWOEHNER, WALTER B., Creole Petr. Corp., Grupo de Geologia, Tia Juana, Venezuela, S.A.
NINE, OGDEN W., JR., Expl. Dept., Arabian American Oil Co., Dhahran, Saudi Arabia
NITECKI, MATTHEW H., Univ. of Chicago, Chicago, Ill.
NIXON, ROBERT P., Mobil Oil Co., Box 1652, Casper, Wyo.
NOREM, W. LUTHER, Richfield Oil Corp., 5900 N. Cherry Ave., Long Beach, Calif.
NORMAN, ROBERT R., Box 682, Moab, Utah
NORRIS, ROBERT M., Univ. of California, Santa Barbara College, Goleta, Calif.
NORTHCUTT, ROBERT A., Pan American Petr. Corp., Box 1092, Shreveport, La.
NORTON, PETER, Pan American Libya Oil Co., Box 982, Tripoli, Libya
*NORTON, STEPHEN A., 155 Winter St., Westwood, Mass.
*NUGENT, ROBERT CHARLES, Northwestern Univ., Evanston, Ill.
NUNLEY, R. K., Amerada Petr. Corp., Box 1498, Billings, Mont.
NYGREN, WALTER ERIC, Standard Oil Co. of Texas, Box 1249, Houston, Tex.

*OBERT, K. RICHARD, 1921½ Castillo St., Santa Barbara, Calif.
*OBREGON DE LA PARRA, Jorge, Laboratorio Paleontologico, Petroleos Mexicanos, Edif. Maracan, Desp. 107, Avenida Juarez y Allende, Monterrey, Mexico
O'CONNELL, JAMES F., Texaco Inc., 1422 Harrison St., Amarillo, Tex.
*OERTLI, H. J., S.N.P.A., Centre de Recherches, Pau, France
*OGNIBEN, LEO, Instituto di Geologia, Corso Italia 21, Catania, Italy.
OGREN, DAVID E., Univ. of Wisconsin, Madison, Wis.
O'HARA, JAMES F., JR., Rooster Springs Ranch, Cedar Valley, Tex.
OHLEN, HENRY ROBERT, Shell Oil Co., 705 W. Municipal Dr., Farmington, N. Mex.
*OINOMIKADO, TSUNETERU, 38, 1-chome, Nagasaki-cho, Toshima-ku, Tokyo, Japan
OLSSON, AXEL A., 1906 Ferdinand St., Coral Gables, Fla.
OLSSON, RICHARD K., 258 Moore St., Princeton, N. J.
OPPEL, RICHARD E., Cabot Carbon Co., Box 4395, Midland, Tex.
*ORCUTT, CHARLES L., Richfield Oil Corp., 5900 Cherry Ave., Long Beach, Calif.
OSBORNE, J. G., Jr., Continental Oil Co., Box 1267, Ponca City, Okla.
OSMOND, JOHN C., Box 1346, Salt Lake City, Utah
OTTO, GEORGE H., 53 W. Jackson Blvd., Chicago, Ill.
*OUGLAND, RONALD MARTIN, 812 W. College Ave., State College, Pa.
OVERTON, CHARLES K., Pan American Petr. Corp., Box 14085, Houston, Tex.
OWEN, EDGAR W., 532 Milam Bldg., San Antonio, Tex.
OWENS, LLOYD D., Standard Oil Co. of California, Bakersfield, Calif.
OXSEN, MELVIN G., Lion Oil Co., 1310 Denver Club Bldg., Denver, Colo.

PACKARD, FRANK A., Humble Oil & Refg. Co., Box 1600, Midland, Tex.
PADGHAM, JOHN B., Standard Oil Co. of Texas, Box 538, Dallas, Tex.
*PAGE, LOU WILLIAMS, 319 Washington Terrace, Middletown, Conn.
PAINE, WILLIAM RHODES, Southwestern Louisiana Inst., Box 174, Lafayette, La.
*PALMER, ALLISON R., 333 U. S. Natl. Museum, Washington, D. C.
PALMER, JAMES E., Missouri School of Mines & Metallurgy, Rolla, Mo.
PALMER, KATHERINE V. W., 206 Oak Hill Rd., Ithaca, N. Y.
PAREDES-PACHECO, MANUEL, International Petr. Co. Ltd., Talara, Peru, S. A.
PARCHMAN, WILLIAM L., JR., Sun Oil Co., 832 Milam Bldg., San Antonio, Tex.
PARDO, GEORGES, Gulf Res. & Devel. Co., Box 2038, Pittsburgh, Pa.
*PARKER, FRANCES L., Scripps Institution of Oceanography, La Jolla, Calif.
PARKER, FRANK S., Signal Oil & Gas Co., 811 W. Seventh St., Los Angeles, Calif.
PARKER, JOHN W., Pan American Petr. Corp., Box 487, Farmington, N. Mex.
PARKER, WILLIAM GILMORE, 4511 Banning Dr., Houston, Tex.
*PARKS, JAMES M., JR., Pure Oil Co., Research Center, Crystal Lake, Ill.
PASSEGA, R., Via Barinetti 1, Milano, Italy
PATMAN, WILLIAM EDWARD, The California Co., 800 The California Co. Bldg., New Orleans, La.
PATTON, JOHN B., Univ. of Indiana, Bloomington, Ind.
PAYNE, THOMAS G., Texaco Research Lab., Bellaire, Tex.
PEARL, WARD C., JR., c/o Ivar Gustafson, 310 N. Harrison St., Ludington, Mich.
PECK, RAYMOND E., Univ. of Missouri, Columbia, Mo.
PEDERSON, SELMER L., American Overseas Petr. (Spain) Ltd., Avenida Del Generalisimo 35, Madrid, Spain
PEES, SAMUEL T., Paria Operations, Inc., Apt. 4312, Correos Del Este, Caracas, Venezuela, S. A.
PELTON, HAROLD A., Mobil Oil Co., Petroleum Club Bldg., Denver, Colo.
*PENDERY, EUGENE C., Texas Technological College, Lubbock, Tex.
*PEPPERS, Russel A., 602 W. Illinois St., Urbana, Ill.

*PERCIVAL, STEPHEN F., JR., Mobil Oil of Canada, Ltd., Box 690, Tripoli, Libya
PERKINS, BOB F., Shell Devel. Co., Box 481, Houston, Tex.
PERUSEK, CYRIL J., 2405 W. Cuthbert, Midland, Tex.
*PESSAGNO, EMILE A., Jr., Univ. of California, Davis, Calif.
*PETERSEN, RICHARD G., U. S. Geol. Survey, Rm. 847, Oliver Bldg., 141 Milk St., Boston, Mass.
PETERSON, JAMES A., Shell Oil Co., Box 158, Farmington, N. Mex.
*PETERSON, JOHN E., 530 S. Washington St., Paxton, Ill.
PETERSON, MARVIN L., Shell Oil Co., 250 Mt. Lebanon Blvd., Pittsburgh, Pa.
*PETERSON, NORMAN V., State Dept. of Geology, Box 417, Grants Pass, Ore.
PETRIE, EDWARD G., British American Oil Co. Ltd., Box 130, Calgary, Alta., Canada
PETRUSEK, BENJAMIN J., Pan American Petr. Corp., Box 14085, Houston, Tex.
PETTERS, VIKTOR, International Petr. (Colombia) Ltd., Bogota, Colombia, S. A.
PETTIJOHN, FRANCIS J., Johns Hopkins Univ., Baltimore, Md.
PETTY, DABNEY E., 4991 View Dr., San Antonio, Tex.
PFEIFFER, DAVID H., Standard Oil Co., of California, Box 3495 Rincon Annex, San Francisco, Calif.
PHILLIPS, HENRY H., Pan American Petr. Corp., Box 14085, Houston, Tex.
PHILPOTT, THOMAS H., Olin Oil & Gas Corp., 1700 Commerce Bldg., New Orleans, La.
PHLEGER, FRED B., Scripps Institution of Oceanography, La Jolla, Calif.
PICARD, M. DANE, Princeton Univ., Princeton, N. J.
*PICKETT, C. RODMAN, Bolivia California Petr. Co., Casilla 653, Cochabamba, Bolivia, S. A..
PIERCE, RICHARD LACY, Richfield Oil Corp., Box 147, Bakersfield, Calif.
PIERSON, J. R., JR., 508 Hester Ave., New Orleans, La.
PINSAK, ARTHUR P., State Geol. Survey, Indiana Univ., Bloomington, Ind.
*PITRAT, CHARLES W., Univ. of Kansas, Lawrence, Kan.
*PITTMAN, EDWARD D., Univ. of California, Los Angeles, Calif.
PITTMANN, J. S., JR., 14 W. Wing Phillips Bldg., Bartlesville, Okla.
*PLATT, LUCIAN B., 105 Washington Rd., Princeton, N. J.
PLUMLEY, WILLIAM J., California Research Corp., Box 446, La Habra, Calif.
*POHN, HOWARD, 4024 Gelber Pl., Los Angeles, Calif.
POLK, THOMAS R., Humble Oil & Refg. Co., Box 150, Miles City, Mont.
POLLACK, JEROME M., Harpur College, Endicott, N. Y.
POLLARD, ROBERT T., 815 American Natl. Bldg., Oklahoma City, Okla.
*POLSON, IRVING L., International Petr. (Colombia) Ltd., Bogota, Colombia, S. A.
POLUGAR, MORTON, Standard Oil Co. of California, Box 278, Oildale, Calif.
*POOBRASERT, SUPARB, Texas A. & M. College, Box 1896, College Station, Tex.
POPE, DAVID E., Union Producing Co., Box 278, Kenner, La.
PORTERFIELD, ROBERT R., 401 Midland Tower, 223 W. Wall, Midland, Tex.
*POWELL, J. DAN, Univ. of Texas, Austin, Tex.
POWERS, MAURICE C., Catawba College, Salisbury, N. Car.
POWNELL, LELAND D., The TXL Oil Corp., 305 N. Marienfeld, Midland, Tex.
PRATT, WALLACE E., Box 209, Carlsbad, N. Mex.
PRATT, WILLIS L., 217 S. West St., Visalia, Calif.
PRAY, L. C., Ohio Oil Co., Box 269, Littleton, Colo.
PROCTER, RICHARD M., Geological Survey of Canada, 406 Customs Bldg., Calgary, Alta., Canada
PRYOR, WAYNE A., Gulf Res. & Devel. Co., Drawer 2038, Pittsburgh, Pa.
*PURDY, EDWARD G., Rice Univ. , Houston, Tex.
PURI, HARBANS S., State Geol. Survey, Box 631, Tallahassee, Fla.
PYE, WILLARD D., Univ. of Arizona, Tucson, Ariz.
PYEATT, LLOYD M., 3419 Nottingham, Houston, Tex.
PYRE, AUGUSTIN, Gulf Eastern Co., 2 Portman St., London, England

QUIGLEY, CLAUDE M., JR., Standard Oil Co. of Texas, Box 66247, Houston, Tex.
QUINLAN, JAMES F., JR., Susquehana Western, Inc., Box 217, Falls City, Tex.

RAASCH, GILBERT O., 1124 Sixteenth St., N.W., Calgary, Alta., Canada
RABANIT, PAUL, Cabinda Gulf Oil Co., C. P. 2950, Luanda, Angola
RAINWATER, E. H., Shell Devel. Co., Box 481, Houston, Tex.
RALL, RAYMOND W., Tennessee Gas & Oil Co., 1820 Wilco Bldg., Midland, Tex.
RAMSDELL, ROBERT C., Williams College, Williamstown, Mass.
RANDALL, A. G., 1448 W. Twenty-ninth Ave., Casper, Wyo.
RANKIN, WILBUR D., 643 S. Flower, Los Angeles, Calif.
*RAO, CHATTY N., Dept. of Geology, Indian Inst. of Technology, Kharagpur, West Bengal, India
*RAPSON, JUNE E., Shell Oil Co., Box 100, Calgary, Alta., Canada
RAU, WELDON W., Washington State Dept. of Conservation, Div. of Mines & Geology, General Administration Bldg., Olympia, Wash.
RAYMOND, PAUL C., Texaco Inc., Box 3109, Midland, Tex.
RECTOR, GLASCO W., 2329 Hyacinth Lane, Wichita, Kan.
REDMOND, CHARLES DAVID, Arabian-American Oil Co., Dhahran, Saudi Arabia

REED, EUGENE C., State Geol. Survey, Univ. of Nebraska, Lincoln, Neb.
REED, EVERETT T., 216 Knox Bldg., Enid, Okla.
REINHART, PHILIP W., 72 Jasmine St., Denver, Colo.
REITER, FRED H., Sohio Oil Co., Box 3167, Midland, Tex.
REITER, MARTIN, 943 W. Two hundred thirty-second St., Torrence, Calif.
RENZ, HANS HERMANN, Mene Grande Oil Co., Apt. 709, Caracas, Venezuela, S. A.
REPENNING, CHARLES A., U. S. Geol. Survey, 345 Middlefield Rd., Menlo Park, Calif.
*RESIG, JOHANNA MARTHA, 145 W. Thirty-third St., Los Angeles, Calif.
RESO, ANTHONY, Amherst College, Amherst, Mass.
REULAND, ALBA, Apt. 576, Maracaibo, Venezuela, S. A.
REVELLE, ROGER, 7348 Vista Del Mar, La Jolla, Calif.
REXROAD, CARL B., Univ. of Houston, Houston, Tex.
*REYNOLDS, E. JULIUS, Humble Oil & Refg. Co., Box 2180, Houston, Tex.
REZAK, RICHARD, Shell Devel. Co., Box 481, Houston, Tex.
RHODES, F. H. T., Univ. College of Swansea, Singleton Park, Swansea, Wales
RHODES, HOWARD S., 907 Forty-Eighth Ave., S.W., Calgary, Alta., Canada.
RHODES, MARY LOUISE, Standard Oil Co. of Texas, 418 Petroleum Tower, Corpus Christi, Tex.
RICCIO, JOSEPH F., 612 Elden Ave., Whittier, Calif.
RICH, MARK, Univ. of North Dakota, Grand Forks, N. Dak.
RICHARDS, ARTHUR, Southern Methodist Univ., Dallas, Tex.
RICHARDS, H. GLENN, Cia Guatemala California de Petroleo, Apt. 1307, Guatemala City, Guatemala, C. A.
RICHARDS, PAUL W., U. S. Geol. Survey, Bowling Green, Ky.
RICHEY, CHARLES I., c/o Riley, 11938 Wink, Houston, Tex.
RICHTER, ROBERT W., Texaco Inc., Box 480, Tyler, Tex.
*RIEDEL, ALFREDO, via dei Fabbri 11, Trieste, Italy
RIGGS, ELLIOTT A., 303 S. Bluff St., Janesville, Wis.
RIGGS, KARL A., 723 Penguin Dr., Dallas, Tex.
RIGGS, WILLIAM A., Gulf Mobile & Ohio Railway, Mobile, Ala.
RILEY, CHARLES M., Humble Oil & Refg. Co., Box 2180, Houston,-Tex.
*RIMSNIDER, DONALD O., The California Co., Box 822, Jackson, Miss.
RINDSIG, JULIA K., Shell Oil Co., Box 1810, Midland, Tex.
RITTENHOUSE, GORDON, Shell Devel. Co., Box 481, Houston, Tex.
*RIVA, JOHN, 919 Furnald Hall, Columbia Univ., New York, N. Y.
RIVEROLL, DAVID D., Continental Oil Co., 1137 Wilshire Blvd., Los Angeles, Calif.
ROBECK, RAYMOND C., 535 Orchard Ave., Grand Junction, Colo.
*ROBERSON, HERMAN E., Harpur College, Endicott, N. Y.
*ROBERTS, JOHN L., Children's Museum, 60 Burroughs St., Jamaica Plain, Mass.
*ROBERTS, PHILIP KENNETH, 938 N. Fourteenth, W., Salt Lake City, Utah
ROBERTS, WILLIAM F., Shell Oil Co., 1008 W. Sixth St., Los Angeles, Calif.
ROBERTSON, HERBERT C., JR., 5926 Victor, Dallas, Tex.
ROBINSON, ROBERT B., Sinclair Research Lab., Box 3006, Tulsa, Okla.
ROBINSON, RON S., McAlester Fuel Co., Box 1608, Midland, Tex.
ROBINSON, VAN D., Atlantic Refg. Co., Box 2819, Dallas, Tex.
ROD, EMILE, Venezuelan Atlantic Refg. Co., Apt. 893, Caracas, Venezuela, S. A.
RODGERS, JACK P., 3505 Sentinel Ave., Midland, Tex.
ROEHL, PERRY O., Shell Oil Co., 1700 Broadway, Denver, Colo.
ROGERS, JAMES K., Arkansas Fuel Oil Corp., Box 117, Shreveport, La.
ROGERS, JOHN J. W., Rice Univ., Houston, Tex.
ROGERS, MICHAEL A., Canadian Pacific Oil and Gas Ltd., Box 896, Calgary, Alta., Canada
ROLSHAUSEN, F. W., R. R. 4, Box 296 B, Houston, Tex.
ROMINGER, JOSEPH F., Esso Standard (Libya), Box 385, Tripoli, Libya
ROOT, SAMUEL I., Intercol, Apt. 3533, Bogota, Colombia, S. A.
ROSS, CHARLES A., State Geol. Survey, Urbana, Ill.
*ROTAN, CLEONE M., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
*ROTH, ELDON S., Barstow Junior College, 425 E. Main St., Barstow, Calif.
ROTHROCK, DAVID P., Humble Oil & Refg. Co., Carter Div., Box 120, Denver, Colo.
ROTHROCK, HOWARD E., Box 902, Coleman, Tex.
ROTHWELL, W. THOMAS, JR., Richfield Oil Corp., 3900 Gaviota Ave., Long Beach, Calif.
*ROY, DONALD H., 103 E. Nobles Ave., Midland, Tex.
ROYE, WALTER WAYNE, 110 N. Big Spring, Midland, Tex.
RUBEY, WILLIAM W., Inst. of Geophysics, Univ. of California, Los Angeles, Calif.
RUCKER, LESTER M., Sun Oil Co., Box 2831, Beaumont, Tex.
*RUDICK, WALTER J., Union Oil Co. of Louisiana, Pioneer Bldg., Lake Charles, La.
RUEFLI, WERNER H., Libya-Shell N. V., Box 1101, Tripoli, Libya
*RUFFIN, JAMES H., 1219 Classen St., Norman, Okla.
*RUGGIERI, GIULIANO, Instituto di Geologia, Corso Calatafimi 260, Palermo, Italy
RUSNAK, GENE A., The Marine Laboratory, Univ. of Miami, Miami, Fla.
RUSSELL, R. DANA, Ohio Oil Co., Box 269, Littleton, Colo.
RUTH, JOHN W., 501 Rosemarie Dr., Arcadia, Calif.

RUTSCH, R. F., Melchenbuehlweg 75, Berne, Switzerland
*RYAN, J. DONALD, Lehigh Univ., Bethlehem, Pa.
RYNIKER, CHARLES, Bolivian Gulf Oil Co., Casilla 1458, Cochabamba, Bolivia, S. A.

SAGE, NATHANIEL M., JR., Office of Sponsored Research, Massachusetts Inst. of Tech., Rm. 5-105, Cambridge, Mass.
SAID, RUSHDY, 22 Road 6, Maadi, Cairo, Egypt
*SAKAKURA, KATSUHIKO, 501 Kugahara-machi, Ota-ku, Tokyo, Japan
SAMUELL, JOHN HOWARD, Box 732, Abilene, Tex.
SANDEFUR, BENNETT T., Michigan State Univ., East Lansing, Mich.
SANDER, NESTOR J., Oasis Oil Co. of Libya, Box 377, Tripoli, Libya
SANDERS, JOHN E., Yale Univ., New Haven, Conn.
SANDERSON, GEORGE A., JR., Shell Oil Co., Box 1509, Midland, Tex.
SANDIDGE, JOHN R., San Antonio College, 1300 San Pedro Ave., San Antonio, Tex.
SANFORD, JOHN T., Wayne State Univ., Detroit, Mich.
SANJUAN, JON, Richmond Exploration Co., Apt. 93, Maracaibo, Venez., S. A.
*SANSCHAGRIN, ROLAND, Univ. of Ottawa, Ottawa, Ont., Canada
*SARIN, DEV DATT, Dept. of Geol., Univ. of Mandalay, Mandalay, Burma
SARMIENTO-SOTO, ROBERTO, Humble Oil & Refg. Co., Carter Div., Box 801, Tulsa, Okla.
SASS, LOUIS CARL, Gulf Oil Corp., Box 35, Bowling Green Sta., New York, N. Y.
*SAWIN, H. J., Univ. of Delaware, Newark, Del.
*SCHAFFEL, SIMON, City College of New York, New York, N. Y.
*SCHENBERGER, RICHARD LEE, 2206 Canyon Dr., Costa Mesa, Calif.
SCHLANGER, SEYMOUR O., Petrobras, Curso de Geologia de Petroleo, Caixa Postal 670, Salvador, Bahia, Brazil, S. A.
SCHLEE, JOHN S., Univ. of Georgia, Athens, Ga.
SCHMID, JACK R., Suite 201, 123 Twenty-sixth Ave., S.W., Calgary, Alta., Canada
*SCHMIDT, RONALD H., 7545 Trenton Ave., University City, Mo.
SCHMIDT, RUTH A. M., U. S. Geol. Survey, 509 Cordova Bldg., Anchorage, Alaska
SCHMIEG, ROBERT E., The California Oil Co., The California Co. Bldg., New Orleans, La.
*SCHNEIDER, MICHAEL C., DePauw Univ., Greencastle, Ind.
*SCHOLL, D. W., U. S. Geol. Survey, 345 Middlefield Rd., Menlo Park, Calif.
SCHOLTEN, ROBERT, Pennsylvania State Univ., University Park, Pa.
*SCHOPF, JAMES M., U. S. Geol. Survey, Ohio State Univ., Columbus, Ohio
SCHREIBER, JOSEPH F., JR., Univ. of Arizona, Tucson, Ariz.
SCHROEDER, MELVIN C., Texas A. & M. College, College Station, Tex.
SCHROEDER, ROBERT J., Shell Oil Co., Box 720, Casper, Wyo.
*SCHULTZ, HILDRETH N., 500 Garland St., Denver, Colo.
SCHWALB, HOWARD RAY, Box 545, Evansville, Ind.
*SCHWARZACHER, WALTHER, Queen's Univ., Belfast, N. Ireland
SCHWEERS, RICHARD H., Texaco Inc., 1512 Commerce St., Dallas, Tex.
SCHWEIGHAUSER, JACOB, c/o B. P. M., Pladju, South Sumatra, Indonesia
*SCHWEITZER, HANS-JOACHIM, Geologisch-Palaeontologisches Institut und Museum, Nussallee 2, Bonn, Germany
SCOTT, ALAN J., Univ. of Texas, Austin, Tex.
*SCOTT, DARCY L., Univ. of British Columbia, Vancouver, B. C., Canada
SCOTT, HAROLD W., Univ. of Illinois, Urbana, Ill.
SCOTT, KENNETH E., Sinclair Oil & Gas Co., 860 St. Charles Ave., New Orleans, La.
SCOTT, W. FRANK, Washington State Univ., Pullman, Wash.
SCRUTON, PHILIP C., Pan American Petr. Corp. Box 1654, Oklahoma City, Okla.
SCULL, BERTON J., Sun Oil Co., 503 N. Central Expressway, Richardson, Tex.
SCURLOCK, C. R., Gulf Oil Corp., Box 774, Evansville, Ind.
*SEALE, J. J., Concrete Conduit Co., Box 31, Colton, Calif.
SEARIGHT, THOMAS K., Illinois State Normal Univ., Normal, Ill.
SECOR, DANA M., Box 37, Midland, Tex.
SEIGLIE, GEORGE A., Comision de Fomento Nacional, Calle O #216, Havana, Cuba
SELIG, A. L., 1907 Bank of the Southwest Bldg., Houston, Tex.
SELLERS, DAVID H. A., Mobil Oil of Canada, Ltd., Financial Bldg., Regina, Sask., Canada
SELLI, RAIMONDO, Istituto di Geologia, Via Zamboni 63, Bologna, Italy
SELLIN, H. A., Mobil Oil Co., Box 177, Houston, Tex.
SETZER, FRANCIS M., Pan American Petr. Corp., Box 14085, Houston, Tex.
*SEVON, WILLIAM DAVID, Geol. Dept., Univ. of Canterbury, Christchurch, New Zealand
SHAFFER, PAUL R., Univ. of Illinois, Urbana, Ill.
*SHANNON, ELLEN C., Box 276, Wickenburg, Ariz.
SHARP, EVERETT R., Atlantic Refg. Co., 444 Seventh Ave., S.W., Calgary, Alta., Canada
SHARP, JOHN A. V., 1951 Grandview D, Boulder, Colo.
SHAUB, BENJAMIN M., 159 Elm St., Northampton, Mass.
SHAVER, ROBERT H., State Geol. Survey, Univ. of Indiana, Bloomington, Ind.
SHAW, ALAN B., 3515 Holland St., Wheat Ridge, Colo.
*SHAW, DANIEL B., Shell Devel. Co., Box 481, Houston, Tex.
*SHAW, GENE L., Shell Oil Co., Box 691, Ventura, Calif.
SHELTON, JOHN W., Shell Oil Co., Box 2099, Houston, Tex.
SHEPARD, FRANCIS P., Scripps Institution of Oceanography, La Jolla, Calif.
SHEPARD, ROBERT H., Pasotex Petr. Co., 800 Fidelity Natl. Bldg., Oklahoma City, Okla.

*SHEPPS, VINCENT C., State Geol. Survey, South Office Bldg., Harrisburg, Pa.
*SHERMAN, DON KERRY, 3575 W. Fifth St., Los Angeles, Calif.
*SHIGO, JOHN J., III, R.D. #1, Box 263L, Bellefonte, Pa.
SHROCK, ROBERT R., Massachusetts Inst. of Technology, Cambridge, Mass.
*SIDES, JAMES WESLEY, School of Mineral Sciences, Stanford, Univ., Stanford, Calif.
SIEMER, WILLIAM J., St. Mary's Univ., San Antonio, Tex.
SIEVER, RAYMOND, Geological Museum 24, Harvard Univ., Cambridge, Mass.
SIMON, LOUIS J., Texaco Inc., 3350 Wilshire Blvd., Los Angeles, Calif.
SIMS, DEWEY LEROY, Mobil Oil Co., Midland, Tex.
*SKEAN, DONALD M., 143 Beech St., Pottstown, Pa.
SKINNER, HUBERT C., Tulane Univ., New Orleans, La.
SKINNER, JOHN W., Humble Oil & Refg. Co., Box 1600, Midland, Tex.
SKOLNICK, HERBERT, Spanish Gulf Oil Co., Apt. 193, Las Palmas de Gran Canaria, Canary Islands
SLEMKO, WILLIAM, Western Decalta Petr. Ltd., 703 Fifth St., S.W., Calgary, Alta., Canada
*SLOAN, ROBERT E., Univ. of Minnesota, Minneapolis, Minn.
SLOSS, LAURENCE L., Northwestern Univ., Evanston, Ill.
SLOSSON, JAMES E., 7113 Bianca Ave., Van Nuys, Calif.
*SMART, BURTON, II, 1900 Wildair Dr., New Orleans, La.
*SMITH, ALEC JAMES, Univ. College of London, Gower St., London, England
*SMITH, BERNICE Y., 3192 Del Verde Ave., Salt Lake City, Utah
SMITH, DAVID D., Louisiana State Univ., Baton Rouge, La
SMITH, DENVER J., Gulf Oil Corp., Box 1590, New Orleans, La.
SMITH, FRED E., Texas A. & M. College, College Station, Tex.
SMITH, FRED L., JR., 1226 Bank of the Southwest Bldg. Houston, Tex.
SMITH, JAMES A., Texaco Inc., Box 817, Farmington, N. Mex.
SMITH, LEE ANDERSON, Stanford Univ., Stanford, Calif.
SMITH, NED MYRON, State Geol. Survey, Univ. of Indiana, Bloomington, Ind.
SMITH, PATSY J., U. S. Geol. Survey, 4 Homewood Pl., Menlo Park, Calif.
*SMITH, RICHARD E., Box 231, College Sta., Pullman, Wash.
*SMITH, ROBERTA K., Univ. of British Columbia, Vancouver, B. C., Canada
SMITH, WILLIAM H., Mississippi State College, State College, Miss.
SMITH, WILLIAM THOMAS, Gulf Res. & Devel. Co., Box 2038, Pittsburgh, Pa.
*SMOOT, THOMAS W., Harbison-Walker Refractories Corp., Garber Res. Center, Box 98037, Pittsburgh, Pa.
SNIDER, JAMES W., Amerada Petr. Corp., Box 2040, Tulsa, Okla.
SNYDER, FRANK G., St. Joseph Lead Co., Bonne Terre, Mo.
SODERSTROM, GLEN S., Texaco Inc., Box 2227, Amarillo, Tex.
*SOHL, NORMAN F., U. S. Geol. Survey, Washington, D. C.
SOHN, I. G., U. S. Natl. Museum, Washington, D. C.
*SOHON, ROBERT S., 469 Palmetto Rd., Bridgeport, Conn.
SONNENBERG, FRANK P., Chaco Petr., S. A., Casilla 1438, Cochabamba, Bolivia, S. A.
SOUAYA, F., Shell House, Box 228, Cairo, Egypt
SPEED, BERT L., Box 131, Adrian, Tex.
SPEED, CARLETON D., 711 Houston Club Bldg., Houston, Tex.
SPEER, JOHN HILL, 909½ Jenkins, Norman, Okla.
SPENCER, JAMES F., 101 W. Jefferson, Pittsburg, Kan.
SPENCER, MARIA, 1606 N. I, Midland, Tex.
SPIEKER, EDMUND M., 4793 Olentangy Blvd., Columbus, Ohio
SPRAUL, GARY L., Amerada Petr. Corp., 1811 Niels Esperson Bldg., Houston, Tex.
SPRENG, A. C., Missouri School of Mines, Rolla, Mo.
SPROULE, J. C., Box 525, Calgary, Alta., Canada
SPROUSE, DONALD W., Humble Oil & Refg. Co., 250 Mt. Lebanon Blvd., Pittsburgh, Pa.
SQUYRES, COY H., Oasis Oil Co., Box 377, Tripoli, Libya
*ST. JEAN, JOSEPH, JR., Univ. of North Carolina, Chapel Hill, N. Car.
STACH, LEO W., 41 Herbert St., Albert Park, S.C.6, Victoria, Australia
STACY, HOWARD E., Dominion Oil, Ltd., Box 199, Port of Spain, Trinidad, W. I.
STAINFORTH, ROBERT M., Creole Petr. Corp., Apt. 172, Maracaibo, Venezuela, S. A.
STANLEY, EDWARD A., Pan American Petr. Corp., Box 591, Tulsa, Okla.
STATLER, ANTHONY T., Pan American Petr. Corp., Box 591, Tulsa, Okla.
STEAD, FREDERICK L., Box 26, Magnolia, Ark.
STEELE, GRANT, Gulf Laboratory, 6901 W. Lakewood Pl., Denver, Colo.
STEHR, RAYMOND A., 4814 Kelsey Rd., Dallas, Tex.
STEINMETZ, RICHARD, Northwestern Univ., Evanston, Ill.
*STENSLAND, CARL H., Soil Conservation Service, Beltsville, Md.
†STENZEL, H. B., 3726 Colquitt, Houston, Tex.
STENZEL, WILLIAM K., Ohio Oil Co., Box 552, Midland, Tex.
*STEPHENSON, GORDON R., Agricultural Research Service, Box 2724, Boise, Ida.
STEPHENSON, LLOYD W., 113 Superior St., Dover, Ohio
STEPHENSON, MORTON B., Pan American Petr. Corp., Box 1654, Oklahoma City, Okla.
*STEPHESON, CLYDE W., 1513 Emery Ave., Bakersfield, Calif.
STERNBERG, CHARLES W., Murphy Corp., El Dorado, Ark.

STEVENS, CALVIN H., 525 W. Works St., Sheridan, Wyo.
STEVENSON, ROBERT EVANS, State Univ. of South Dakota, Vermillion, S. Dak.
*STEVENSON, ROBERT EVERETT, 525 Princeton Circle West, Fullerton, Calif.
*STEWART, DUNCAN, Carleton College, Northfield, Minn.
STEWART, GRACE A., 1315 E. Adams St., Tucson, Ariz.
STEWART, JOHN C., Mobil Oil Co., Apt. del Este 5373, Caracas, Venezuela, S. A.
STEWART, WENDELL J., Texaco Inc., Box 3109, Midland, Tex.
STILL, J. T., 1200 N. Main, San Antonio, Tex.
STINEMEYER, EDWIN H., JR., Shell Oil Co., Box 999, Bakersfield, Calif.
STIPP, MEREDITH R., Standard Oil Co. of Texas, Box 746, Roswell, N. Mex.
STOKES, WILLIAM LEE, Univ. of Utah, Salt Lake City, Utah
STONE, BENTON, International Petr. (Colombia), Ltd., Apt. Aereo 3533, Bogota, Colombia, S.A.
*STONE, JOHN E., Univ. of Texas, Austin, Tex.
STONE, SOLON W., Humble Oil & Refg. Co., Carter Div., Box 318, Billings, Mont.
STOUGH, JOAN B., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
*STUART, ALFRED W., 1811 Grandin Rd., Roanoke, Va.
STUBBS, PETER J., 682 Fourth Natl. Bank Bldg., Wichita, Kan.
STUBBS, SIDNEY A., Box 1624, Houston, Tex.
STUCKEY, CHARLES W., JR., Union Oil Co. of California, 800 Prudential Bldg., Houston, Tex.
STUDT, CHARLES W., Union Gas System Inc., Independence, Kan.
STUMM, ERWIN C., Univ. of Michigan, Ann Arbor, Mich.
*STURGEON, MYRON T., Ohio Univ., Athens, Ohio
STURZ, CHARLES E., Tidewater Oil Co., Kumrular Sokagi No. 6, Yenisehir, Ankara, Turkey
SUMMERS, GEORGE E., JR., Box 1465, Bismarck, N. Dak.
SUMMERSON, CHARLES H., Ohio State Univ., Columbus, Ohio
SUNDERMAN, JACK A., Indiana Geol. Survey, Indiana Univ., Bloomington, Ind.
SUTHERLAND, PATRICK K., Univ. of Oklahoma, Norman, Okla.
SUTTON, ERAL M., Bolivia Calif. Petr. Co., Casilla 653, Cochabamba, Bolivia, S. A.
SUTTON, ROBERT G., Univ. of Rochester, Rochester, N. Y.
SWAIN, FRED M., Univ. of Minnesota, Minneapolis, Minn.
SWANN, DAVID H., Illinois Geol. Survey, Natural Resources Bldg., Urbana, Ill.
*SWARTZ, FRANK M., Pennsylvania State Univ., University Park, Pa.
SWEET, WALTER C., Ohio State Univ., Columbus, Ohio
SWETT, KEENE, 1951 Grandview Ave., Apt. H, Boulder, Colo.
SWINEFORD, ADA, State Geol. Survey, Univ. of Kansas, Lawrence, Kan.
SWIRCZYNSKI, RICHARD P., Box 1848, Casper, Wyo.

*TABBERT, ROBERT L., Mobil Oil Co., Box 900, Dallas, Tex.
TANK, RONALD WARREN, 215-W, University Apts., Bloomington, Ind.
TANNER, WILLIAM F., Florida State Univ., Tallahassee, Fla.
TARBET, LOYAL A., Standard Oil Co. of California, Box 1076, Salt Lake City, Utah
TARTAMELLA, NATALE J., Standard Oil Co. of Texas, Corpus Christi, Tex.
TASCH, PAUL, Univ. of Wichita, Wichita, Kan.
TASMAN, MEHLIKA, Esso Standard (Turkey) Inc., Bayindir Sokak 5/15, Yenisehir—Ankara, Turkey
TATOR, BEN A., c/o Mrs. A. Constable, Dr. Fink Rd., Pleasant Valley, N. Y.
‖TAVERNIER, R., University of Ghent, Geological Institute, Rozier 6, Ghent, Belgium
*TAYLOR, DWIGHT W., 2425 Wyoming Ave., Washington, D. C.
TAYLOR, JAMES C., Shell Oil Co., 1008 W. Sixth St., Los Angeles, Calif.
TAYLOR, W. E., Union Producing Co., Box 1020, Jackson, Miss.
TEICHERT, CURT, U. S. Geol. Survey, Federal Center, Denver, Colo.
TEITZ, HERBERT H., Tennessee Oil & Gas Co., Box 105, Calgary, Alta., Canada
*TENCH, ROBERT N., c/o Carleton D. Speed, Jr., 711 Houston Club Bldg., Houston, Tex.
TERCIER, JEAN, Inst. de Geol. de l'Universite Perolles, Fribourg, Switzerland
*TERMIER, HENRI, 131 Av. de Versailles, Paris, France
TERRIERE, ROBERT T., Cities Service Res. & Devel. Co., 920 E. Third St., Tulsa, Okla.
*TERRY, R. D., 21617 Paul Ave., Torrance, Calif.
TESTER, ALLEN C., State Univ. Iowa, Iowa City, Iowa
TEXTORIS, DANIEL ANDREW, 509 W. Main St., Apt. 3, Urbana, Ill.
†THALMANN, HANS E., Stanford Univ., Stanford, Calif.
*THARIN, JAMES C., Univ. of Illinois, Urbana, Ill.
THEESSEN, ERIC JOHANNES, Shell Oil Co., 2005 Alamo Natl. Bank Bldg., San Antonio, Tex.
THOMAS, CHESTER E., 549 Sunnyside Ave., Webster Groves, Mo.
THOMAS, NORMAN L., Pure Oil Co., 35 E. Wacker Dr., Chicago, Ill.
THOMASSON, M. RAY, Shell Oil Co., Box 1509, Midland, Tex.
THOMPSON, M. L., State Geol. Survey, Univ. of Illinois, Urbana, Ill.
THOMPSON, ROBERT W., Scripps Institution of Oceanography, La Jolla, Calif.
THOMPSON, SAM, III, Humble Oil & Refg. Co., Box 1287, Roswell, N. Mex.
THOMPSON, S. A., Mobil Oil Co., Box 900, Dallas, Tex.
THOMPSON, WARREN C., Office of Naval Re-

search, Navy #100, Box 39, Fleet Post Office, New York, N. Y.
THOMPSON, WARREN O., Univ. of Colorado, Boulder, Colo.
THOMPSON, WILLIAM J., Continental Oil Co., Box 1267, Ponca City, Okla.
THOMSON, ALAN F., 1001 Tarleton St., Midland, Tex.
*THORP, E. M., Soil Conservation Service, 134 S. Twelfth St., Lincoln, Neb.
TIERNEY, JAMES A., Gulf Oil Corp., Box 2506, Charleston, W. Va.
TIPSWORD, HOWARD L., Mobil Oil Co., Box 3308, Bellaire, Tex.
TODD, ROBERT G., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
TODD, THOMAS W., California Research Corp., Box 446, La Habra, Calif.
TOOMEY, DONALD F., Shell Devel. Co., Box 481, Houston, Tex.
TORIYAMA, RYUZO, Faculty of Science, Kyushu Univ., Hakozaki, Fukuoka, Japan
TOULMIN, LYMAN D., Florida State Univ., Tallahassee, Fla.
TOURTELOT, HARRY A., U. S. Geol. Survey, Federal Center, Denver, Colo.
TOWE, KENNETH M., Univ. of Illinois, Urbana, Ill.
*TOY, BILLY R., Mobil Oil Co., Box 3308, Bellaire, Tex.
TRAPESONIAN, MICHAEL, 636 Orange Grove Ave., San Fernando, Calif.
TRASK, PARKER D., 240 Southampton Ave., Berkeley, Calif.
*TRAVERSE, ALFRED, Shell Devel. Co., Box 481, Houston, Tex.
TRAXLER, J. DOUGLAS, 15510 Friends St., Pacific Palisades, Calif.
TREADWELL, ROBERT C., Pan American Petr. Corp., Drawer 1980, Corpus Christi, Tex.
*TREFETHEN, JOSEPH M., Univ. of Maine, Orono, Me.
*TRESSELT, PETER, 35635 Beach Rd., Capistrano Beach, Calif.
*TREVES, SAMUEL B., Univ. of Nebraska, Lincoln Neb.
*TREVISAN, LIVIO, Instituto de Geologia, Via S. Maria 31, Pisa, Italy
TRIMM, WARREN M., 5611 Arboles Dr., Houston, Tex.
TRIPP, R. MAURICE, 15231 Quito Rd., Saratoga, Calif.
TROWBRIDGE, A. C., State Univ. Iowa, Iowa City, Iowa
TSCHOPP, H. J., Am. Ausserberg 53, Riehen-Basle, Switzerland
TUCKER, RODNEY J., Amerada Petr. Corp., Box 1009, Williston, N. Dak.
TULLIS, EDWARD L., South Dakota School of Mines, Rapid City, S. Dak.
TURK, LON B., 908 First Natl. Bldg., Oklahoma City, Okla.
TURNER, FRANCIS E., Union Oil Co. of California, Box 7600, Los Angeles, Calif.
TURNER, GREGORY L., Pure Oil Co., Box 239, Houston, Tex.
TWINING, JOHN T., Shell Oil Co., Box 1861, Corpus Christi, Tex.
TWISS, PAGE CHARLES, Kansas State Univ., Manhattan, Kan.
*TYLER, STANLEY A., Univ. of Wisconsin, Madison, Wis.
TYRRELL, WILLIS W., JR., Pan American Petr. Corp., Box 591, Tulsa, Okla.

*UBAGHS, GEORGES J. C., Universite, Institute de Paleontologie, 7 Place du Vingt Aout, Liege, Belgium
UCHUPI, ELAZAR, 2667 S. Ellendale Pl., Apt. 102, Los Angeles, Calif.
ULVOG, CARL, Sunray Mid-Continent Oil Co., Midland, Tex.
UNKLESBAY, ATHEL G., Univ. of Missouri, Columbia, Mo.
UPSHAW, CHARLES FRANCIS, Pan American Petr. Corp., Box 591, Tulsa, Okla.

VALENTINE, JAMES W., Univ. of Missouri, Columbia, Mo.
VAN ANDEL, TJ. H., Scripps Institution of Oceanography, La Jolla, Calif.
VAN ARSDALE, BYRON EUGENE, JR., Continental Oil Co., Box 68, Harvey, La.
*VAN BAREN, F. A., Rooseveltlaan 99, Amsterdam-Z, Netherlands
*VAN DEN BOLD, WILLEM A., Louisiana State Univ., Baton Rouge, La.
VAN HOUTEN, FRANKLYN B., Princeton Univ., Princeton, N. J.
VAN LANDINGHAM, SAMUEL L., 1205 W. Washington, Midland, Tex.
VAN LOPIK, JACK R., Waterways Experiment Station, Vicksburg, Miss.
VAN OS, BILL, Richfield Oil Corp., 320 Seventh Ave., S.W., Calgary, Alta., Canada
*VAN RAADSHOOVEN, BERTRAM, 186 Adrianalaan, Rotterdam, Netherlands
*VAN SANT, JAN F., Univ. of Kansas, Lawrence, Kan.
VANSTRUM, VINCENT V., Florida State Univ., Tallahassee, Fla.
VAN ZELE, MATHILDA, Standard Oil Co. of California, Box 606, La Habra, Calif.
VARVARO, GASPER GUS, Southwestern Louisiana Inst., Lafayette, La.
*VATAN, A., 60 Avenue d'Iena, Paris, France
VAUSE, JAMES E., JR., Humble Oil & Refg. Co., Drawer 1490, Jackson, Miss.
VIGNEAUX, MICHEL-FRANCOIS, 80 Rue Furtado, Bordeaux, France
VINSON, GEORGE L., Esso Standard (Guatemala) Inc., Apt. 1337, Guatemala City, Guatemala, C. A.
VONDERSCHMITT, LOUIS, Geol. Institute, Bernoullianum, Basle, Switzerland
*VON KOENIGSWALD, G. H. R., Geological Institute, Oude Gracht 320, Utrecht, Netherlands
*VORMELKER, RICHARD S., 3481 McFarlin, Dallas, Tex.

WACHEL, MARTIN J., JR., Shell Oil Co., 1200 First National Bank Bldg., Oklahoma City, Okla.
WADE, F. ALTON, Texas Technological College, Lubbock, Tex.

*WAHL, FLOYD M., Univ. of Illinois, Urbana, Ill.
*WAINES, RUSSELL H., 3125 College Ave., Apt. 10, Berkeley, Calif.
WAINWRIGHT, JOHN E. N., Shell Devel. Co., Box 481, Houston, Tex.
*WALDO, A. W., 2030 N. Grange Ave., Stockton, Calif.
WALDSCHMIDT, W. A., 311 Leggett Bldg., Midland, Tex.
WALES, DARREN W., Richfield Oil Corp., 5900 Cherry Ave., Long Beach, Calif.
*WALKER, DAVID BRUCE, British Petr. Co., BP House, Ropemaker St., London, England
WALKER, FRANK H., 2804 Clays Mill Rd., Lexington, Ky.
*WALKER, KENNETH R., Univ. of North Carolina, Chapel Hill, N. Car.
WALKER, THEODORE R., Univ. of Colorado, Boulder, Colo.
WALLACE, MAURICE H., 929 East Side Blvd., Muskogee, Okla.
WALLER, HARRY O'NEAL, 700 San Vicente Blvd., Santa Monica, Calif.
WALTERS, ROBERT F., 510 Orpheum Bldg., Wichita, Kan.
WALTON, WILLIAM R., Pan American Petr. Corp., Box 3092, Houston, Tex.
WANLESS, HAROLD R., Univ. of Illinois, Urbana, Ill.
WARD, ALBERT NOLL, JR., 2828 E. Thirty-fourth St., Tulsa, Okla.
WARDLAW, NORMAN C., Univ. of Saskatchewan, Saskatoon, Sask., Canada
*WARNE, SLADE ST. JOHN, University of New South Wales, Box 1, Kensington, N.S.W., Australia
WARREN, ALBERT D., Mobil Oil Co., Box 3308, Bellaire, Tex.
WARREN, TOM H., Standard Oil Co. of Texas, Box 538, Dallas, Tex.
WARTHIN, A. S., JR., Vassar College, Poughkeepsie, N. Y.
WATERS, JAMES A., 308 Shadywood, Seagoville, Tex.
*WATKINS, J. LLOYD, Midwestern Univ., Wichita, Falls, Tex.
WATKINS, JAMES G., 18151 Lisa St., Huntington Beach, Calif.
*WATSON, JOHN, California Inst. of Technology, Pasadena, Calif.
WATSON, RALPH M., JR., 209 Harding Ave., Blacksburg, Va.
WEART, RICHARD C., Sun Oil Co., 1608 Walnut St., Philadelphia, Pa.
WEAVER, CHARLES E., Continental Oil Co., Box 1267, Ponca City, Okla.
WEAVER, DONALD WARD, Univ. of California at Santa Barbara, Goleta, Calif.
*WEBER, JON N., Univ. of Toronto, Toronto, Ont., Canada
*WEBER, ROLF, Petrobras, Forte Jequitaia, Av. Frederico Pontes S/n, Salvador, Bahia, Brazil, S. A.
*WEGMANN, EUGENE, Fbg de l'hopital 43, Neuchatel, Switzerland
WEIR, GORDON W., U. S. Geol. Survey, 4 Homewood Pl., Menlo Park, Calif.
WEISS, MALCOLM P., Ohio State Univ., Columbus, Ohio
WEIST, WILLIAM G., JR., U. S. Geol. Survey, Federal Center, Denver, Colo.
WEYMOUTH, A. ALLEN, Petrolera Dominicana, c. por A., Apt. 1265, Ciudad Trujillo, Dominican Republic
WESTMORELAND, FRANK S., 2311 Dunstan Rd., Houston, Tex.
WESTHEIMER, JEROME M., 815 Third Ave., S.W., Ardmore, Okla.
WESER, OSCAR E., Standard Oil Co. of California, Box 606, La Habra, Calif.
WENGERD, SHERMAN A., Univ. of New Mexico, Albuquerque, N. Mex.
WELLER, J. MARVIN, Univ. of Chicago, Chicago, Ill.
WELDER, FRANK A., Northeast Central College, Monroe, La.
*WELDAY, EDWARD E., Los Angeles County Geologist, Box 2418, Terminal Annex, Los Angeles, Calif.
WELBY, CHARLES W., Trinity College, Hartford, Conn.
*WEYNSCHENK, R., Peter Maystr. 7, Innsbruck, Austria
WHEELER, HARRY E., Univ. of Washington, Seattle, Wash.
*WHEELWRIGHT, MONA VYONNE, 466 Twelfth Ave., Salt Lake City, Utah
*WHITAKER, J. H. MCDONALD, University College, Leicester, England
*WHITE, MARK M., Standard Oil Co. of California, Box 606, La Habra, Calif.
WHITE, MAYNARD P., Sedgewick, Queenstown, Md.
WHITE, WILLIAM R., Texaco Inc., 3350 Wilshire Blvd., Los Angeles, Calif.
WHITLEY, F. L., 3404 N. Robinson Rd., Texarkana, Tex.
WHITTON, ANN V., Standard Oil Co. of California, Box 606, La Habra, Calif.
*WICKENDEN, ROBERT T. D., Geological Survey of Canada, Customs Bldg., Calgary, Alta., Canada
WIESE, JOHN H., Richfield Oil Corp., 1900 Crescent Ave., Anaheim, Calif.
WILBERT, WILLIAM POPE, Univ. of Texas, Austin, Tex.
WILDE, GARNER LEE, Humble Oil & Refg. Co., Box 1600, Midland, Tex.
WILEY, RICHARD A., Amerada Petr. Corp., Box 1754, Lafayette, La.
*WILIE, WILLIAM L., JR., 1405 McFaddin, Beaumont, Tex.
WILLIAMS, EDWIN P., Hudson's Bay Oil & Gas Co., 320 Seventh Ave., W., Calgary, Alta., Canada
WILLIAMS, GEORGE A., 822 W. "A" St., Moscow, Ida.
WILLIAMS, HAROLD L., Paleontological Laboratory, Box 51, Midland, Tex.
WILLIAMS, HARRY F., 6300 N. Central Expressway, Dallas, Tex.
*WILLIAMSON, IAIN A., Dept. of Mining & Geology, Mining College, Wigan, Lancashire, England

WILLIS, RONALD P., Richmond Expl. Co., Apt. 93, Maracaibo, Venezuela, S. A.
WILSON, FRANCIS S., Gulf Oil Co. of Libya, Box 599, Tripoli, Libya
WILSON, GEORGE M., 505 W. Vermont, Urbana, Ill.
WILSON, JAMES LEE, Shell Devel. Co., Box 481, Houston, Tex.
WILSON, JOHN A., Univ. of Texas, Austin, Tex.
WILSON, LEONARD R., Univ. of Oklahoma, Norman, Okla.
*WILSON, ROBERT L., Univ. of Chattanooga, Chattanooga, Tenn.
WIMBERLEY, C. STANLEY, Allan Hancock Foundation, Univ. of Southern California, Los Angeles, Calif.
WIMBISH, F. E., 54 Rue de Londres, Paris, France
WINDER, C. G., Univ. of Western Ontario, London, Ont., Canada
*WINGARD, PAUL S., Kansas State Univ., Manhattan, Kan.
WINGERT, JOHN R., The California Oil Co., Box 1076, Salt Lake City, Utah
WINKLER, VIRGIL D., Creole Petr. Corp., Apt. 889, Caracas, Venezuela, S. A.
WINSLOW, ARMOUR C., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
WINSLOW, JOHN D., U. S. Geol. Survey, Box 229, Albany, N. Y.
WINTERS, STEPHEN S., Florida State Univ., Tallahassee, Fla.
*WISSEMA, G. G., Spreeuwenlaan 38, The Hague, Netherlands
WISSLER, STANLEY G., Union Oil Co. of California, Box 7600, Los Angeles, Calif.
WONFOR, JOHN S., British American Oil Co., Ltd., Financial Bldg., Edmonton, Alta., Canada
WONG, JACKSON, 13603 S. Mariposa Ave., Gardena, Calif.
WOOD, LEONARD E., Mobil Oil of Canada Ltd., Libyan Branch, Box 690, Tripoli, Libya
WOODARD, ROBERT L., Standard Oil Co. of Texas, Box 538, Dallas, Tex.
*WOODARD, WILLIAM T., 1868 Willow St., San Diego, Calif.
WOODFORD, A. O., 760 W. Ninth St., Claremont, Calif.
WOODROW, DONALD L., Box 352, Mars, Pa.
WOODS, RAYMOND D., Humble Oil & Refg. Co., Box 2180, Houston, Tex.
WOODSIDE, PHILIP R., 2021 Laurel Ct., Falls Church, Va.
WOOTTON, CECIL MAX, Union Producing Co., Box 711, Beeville, Tex.
WORKMAN, L. E., Canadian Stratigraphic Service, 705 Eleventh Ave., W., Calgary, Alta., Canada
WOZAB, DAVID H., 3585 Las Flores Blvd., Lynwood, Calif.
WRATHER, W. E., 4710 Woodway Lane, Washington, D. C.
WRAY, JOHN L., Ohio Oil Co., Box 269, Littleton, Colo.
WRIGHT, FREDERICK F., Columbia Univ., New York, N. Y.
WULF, GEORGE R., Mobil Oil Co. of Canada, Ltd., Box 690, Tripoli, Libya

*YEAKEL, LLOYD S., JR., Shell Devel. Co., Box 481, Houston, Tex.
YENNE, KEITH A., DeGolyer & MacNaughton Inc., 5625 Daniels Ave., Dallas, Tex.
YOLE, R. W., Univ. of British Columbia, Vancouver, B. C., Canada.
*YON, JAMES WILLIAM, JR., State Geol. Survey, Box 631, Tallahassee, Fla.
YOUNG, GERALD C., Standard Oil Co. of California, Box 1076, Salt Lake City, Utah
YOUNG, GORDON A., Mene Grande Oil Co., Apt. 709, Caracas, Venezuela, S. A.
YOUNG, HARVEY C., Kentucky Geological Consultants, Inc., Box 456, Greensburg, Ky.
YOUNG, KEITH P., Univ. of Texas, Austin, Tex.
YOUNG, ROBERT S., 113 Bennington Rd., Charlottesville, Va.
YOUNGQUIST, WALTER, Box 5201, Univ. Station, Eugene, Ore.

ZELLER, EDWARD, Univ. of Kansas, Lawrence, Kan.
*ZIMMERLE, WINFRIED, Deutsche Erdoel-Aktiengesellschaft, Hauptlaboratorium fuer Erdoelgewinnung, 20A Wietze Krs., Celle, Germany
ZIMMERMAN, DONALD A., Sun Oil Co., 503 N. Central Expressway, Richardson, Tex.
*ZIMMERMAN, FRITZ R., Elfenauweg 27, Berne, Switzerland
ZINGULA, RICHARD PAUL, Humble Oil & Refg. Co., Box 2180, Houston, Tex.

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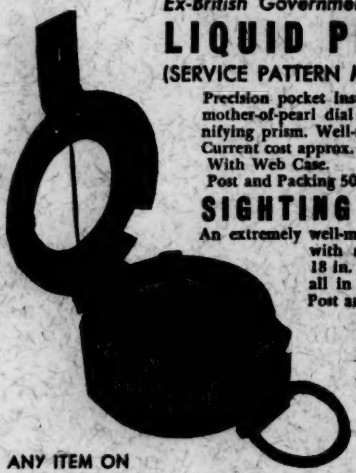

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